

## CHAPTER 3: PROPOSED ACTION AND ALTERNATIVES

The regulations of the Council on Environmental Quality (CEQ) (40 CFR Parts 1500-1508) direct federal agencies to identify and assess, in the environmental impact statement (EIS), reasonable alternatives to the proposed action that meet the purpose and need for action and could have effects on the quality of the human environment. Additionally, CEQ regulations require a presentation in a comparative format of the potential effects each alternative may have on the quality of the human environment.

This chapter describes the proposed action, the siting alternatives for implementation of the proposed action, and the No-Action Alternative. It also describes the technological and siting alternatives that were previously considered and eliminated from detailed analysis in this FEIS, along with the reasoning for their elimination. The description of the proposed action and alternatives, coupled with the description of the affected environment (Chapter 4), enables the analysis of the potential environmental consequences of construction and operation of the proposed Spallation Neutron Source (SNS) (Chapter 5 and summarized in Section 3.5).

### 3.1 OVERVIEW

The proposed action is to design, construct, and operate a state-of-the-art neutron science facility based on a linear accelerator (linac) coupled with proton accumulator rings and a mercury spallation target. This facility, referred to as the proposed SNS, would satisfy the purpose and need for actions by the Department of Energy (DOE). The SNS would initially have an operating power of 1 MW. Additional structures and components are planned that could allow future increases in operating power to 4 MW and additional research capabilities.

This chapter of the proposed SNS FEIS provides a statement of the proposed action and gives a description of the activities that would be undertaken to implement it in Section 3.2. The description of the proposed action is divided into four major sections. Section 3.2.1 identifies the facility components of the proposed SNS at 1 MW and at 4 MW. Section 3.2.2 describes the activities that would be required to construct the proposed SNS. The description entails initial construction and future upgrades that could be proposed for the facility. Section 3.2.3 characterizes operational activities in terms of resource requirements, emissions, discharges, and waste generation that would be involved in operating the proposed SNS over its planned 40-year life span.

Because the facility is being designed to allow future upgrades, discussions evaluating the proposed SNS activities and potential effects include the proposed 1-MW facility and the potential 4-MW-upgraded facility as the upper bounding condition. Furthermore, the discussion emphasizes specific activities with environmental protection implications and includes any known pollution source terms that would be associated with them.

A screening process was used to identify and evaluate potential siting alternatives for the proposed SNS. Initially, a pool of 39 DOE sites

were examined as potential host sites for the proposed SNS (refer to Appendix B). Using specific evaluation criteria, all but four sites were eliminated from detailed analysis in the FEIS (refer to Appendix B). The remaining four alternative DOE sites, Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Argonne National Laboratory (ANL), and Brookhaven National Laboratory (BNL), each contain a selected on-site location that is identified in Sections 3.2.5.2 through 3.2.5.5 and described in detail in Chapter 4. The screening process used to select these four DOE sites from the original 39 alternatives is described in Section 3.2.4. Because each of the selected sites has unique characteristics (especially with regard to road access, availability of utilities, and existing waste management systems), implementation of the construction and operational portions of the proposed action would be somewhat different at each site. The unique site characteristics and the various activities required to deal with these differences are accounted for in this FEIS. (Refer to Appendix B for the site selection reports.)

Under the No-Action Alternative, DOE would not build the proposed SNS. Impacts associated with this option are discussed in Section 3.3 and used for comparison to the action alternatives throughout this FEIS.

A number of technological alternatives to the proposed action were identified and screened prior to initiation of the proposed SNS EIS process. As a result of these evaluations, none were deemed to be viable technological alternatives to the proposed action, and all were eliminated from detailed analysis in the FEIS. These alternatives and the reasoning behind their elimination are discussed in Section 3.4.

The discussion of the proposed action and alternatives concludes in Section 3.5 with a comparison of the potential environmental impacts associated with constructing and operating the proposed SNS at each of the four alternative DOE sites.

## 3.2 THE PROPOSED ACTION

The proposed action is to construct and operate a state-of-the-art neutron science facility to help satisfy the nation's future needs for neutron scattering research. The key attributes of such a facility are the ability to provide (1) an array of neutron beams with varied, discrete energy levels that can be adapted to the particular experiment to be conducted and (2) the highest possible neutron flux onto the research samples. Therefore, it is proposed to construct a new spallation neutron source based on a non-superconducting, linear accelerator with 1-MW beam power coupled with proton accumulator rings and a mercury target. Sufficient design flexibility would be incorporated into the project to allow significant facility modification at some time in the future to increase the power of the proton beam to 4 MW. The proposed SNS would produce short pulses of neutrons through the spallation process. A description of the proposed action is divided into the following three subsections:

- 3.2.1 Facility Description
- 3.2.2 Construction
- 3.2.3 Operations

Descriptions in these sections reflect the current details of planning and engineering at the conceptual design stage of the project. Because detailed site engineering studies have not been performed, this discussion is generic in nature;

the facility described here could be constructed at any of the four alternative sites. Details that would be site-specific are presented in Section 3.2.4. This descriptive information is condensed from the information included in the *National Spallation Neutron Source Conceptual Design Report/Volumes 1 and 2* (ORNL 1997a and 1997b). For a more in-depth technical discussion, the reader is directed to that document, which is available in the DOE reading rooms listed in Chapter 1.

### 3.2.1 FACILITY DESCRIPTION

This summary includes a brief physical description of each of the four main components of the proposed SNS and an explanation of their functions. These basic components for the proposed 1 MW facility include a proton ion source (the front end), the linac, the beam transport and ring system, and the target building that houses the target (Figure 3.2.1-1). This summary description of the proposed SNS facility concludes with a discussion of future upgrade options (Section 3.2.1.5) that would enable the proposed SNS to operate at 4 MW.

#### 3.2.1.1 Front End

The Front End is the part of the proposed SNS accelerator that initially produces the charged hydrogen ions and injects them into the linac. It comprises several components: the ion source, the low-energy beam transport (LEBT), the radio frequency quadrupole (RFQ) accelerator, and the medium-energy beam transport (MEBT). The Front End would be

#### The Production of Neutrons for Research: “Spallation”

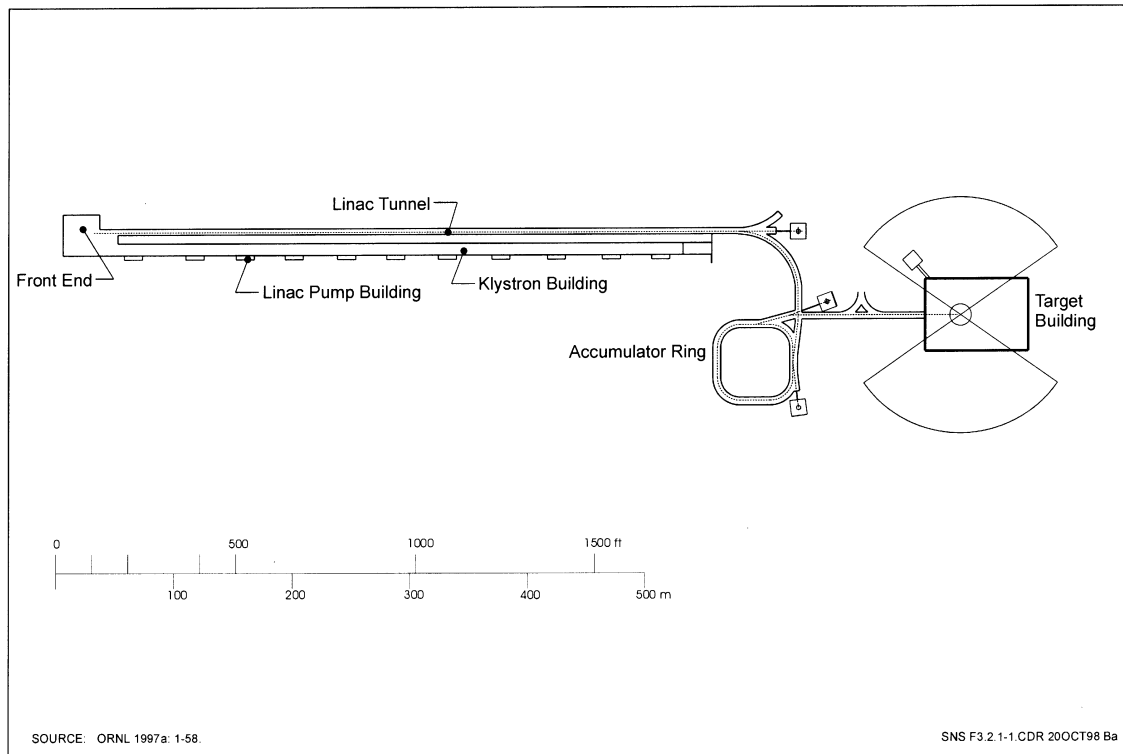
The production of neutrons by the spallation process would begin with the acceleration of high-energy particles within a linac (linear accelerator). The linac would accelerate charged particles, in this case hydrogen atoms, with an extra electron ( $H^-$  ions). Electrons would be stripped from the  $H^-$  ions during injection of the particle into an accumulator ring, leaving protons. Protons would be added to the ring until a sufficient number have been accumulated. The protons would then be directed to a target of liquid mercury. High-energy protons would impact mercury molecules in the target, which, in turn, would eject neutrons to dissipate the proton-impact energy. These high-energy neutrons would travel through a substance that decreases or moderates their energy. The neutrons would then be directed through beam tubes to experiment stations.

The number of neutrons produced in the spallation process would depend on the number and energy of the protons bombarding the target. The number of neutrons available per unit of time for experimental use would depend on the target/moderator system efficiency. The total number of neutrons generated for scattering experiments would depend upon the repetition rate of the proton pulse.

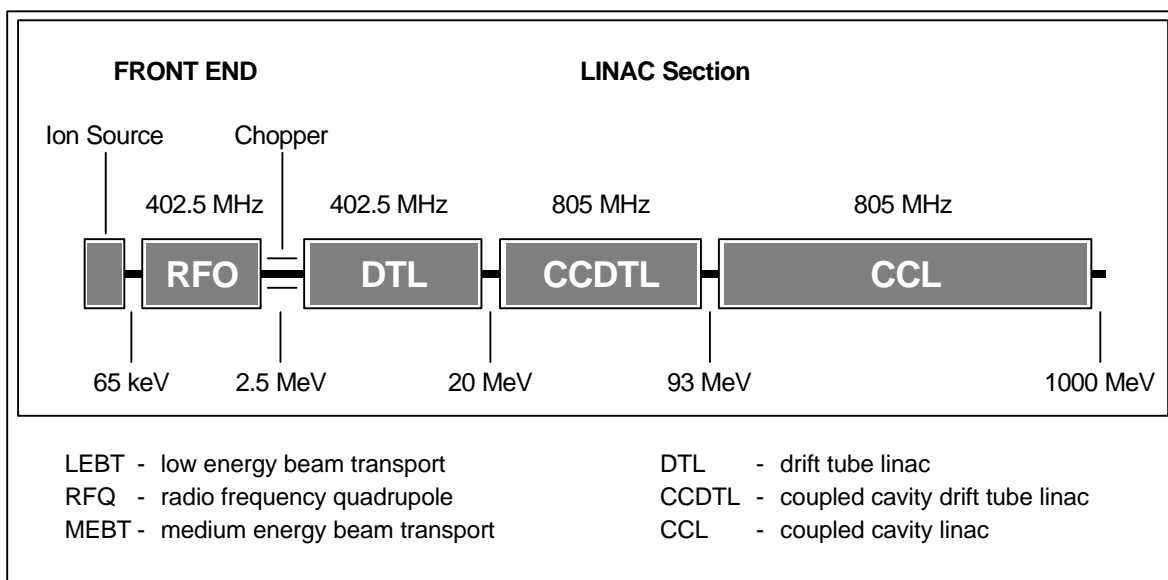
approximately 32.81 ft (10 m) in length. Figure 3.2.1.1-1 presents a schematic diagram of the Front End and linac systems, showing ion source, RFQ accelerator, drift-tube linac (DTL), coupled-cavity drift-tube linac (CCDTL), and coupled-cavity linac (CCL) structures of the proposed SNS.

##### 3.2.1.1.1 Low-Energy Beam Transport

The charged particles produced by the ion source are made to move as a beam, much like a beam of light produced by a laser. The particle beam would leave the ion source and immediately enter the LEBT section of the Front End. During passage through the LEBT, the particles would be grouped into bundles, focused, and accelerated to 65 keV. The LEBT would contain two electromagnetic lenses to focus the beam of particles before it enters the next component of the Front End, the RFQ accelerator.



**Figure 3.2.1-1. Footprint of the proposed SNS accelerator components.**



**Figure 3.2.1.1-1. Schematic layout of the LEBT Front End and linac section.**

### 3.2.1.1.2 Radio-Frequency Quadrupole Accelerator

The RFQ takes the beam and converts it into a continuous controlled stream consisting of many bunches of particles. The RFQ is named for the symmetrical arrangement of four triangle-shaped vanes that form a small hole through which the beam would pass. These vanes assist in converting the ion stream into packets, or bunches of particles, and controlling the beam within the RFQ. During operation of the RFQ, an oscillating voltage from a 402-MHz klystron would be applied that would accelerate the particles. During this acceleration process, the RFQ would increase the energy of the particle beam from 65 keV to a medium energy of 2.5 MeV. The particles leaving the RFQ would enter the MEBT.

### 3.2.1.1.3 Medium-Energy Beam Transport

The MEBT would allow the particles from the RFQ to enter the next stage of energy increase or acceleration. The MEBT would finish forming the beam and would also transport the fully organized medium-energy particle beam to the linac to further increase the energy of the particles. The beam would be focused and grouped together with gaps between successive bunches. The particles leaving the MEBT would proceed to the next stage of acceleration in the linear accelerator proper.

*Klystron:* a specialized electron tube designed to amplify microwave signals or radio waves. There would be a total of 58 klystrons contained in the gallery of the proposed SNS. The klystrons provide the radio frequency (rf) power at the appropriate frequency to accelerate the particles in the linac.

### 3.2.1.2 Linear Accelerator System

The 1,614-ft (492-m) long linac accepts the beam that has been accelerated by the Front End and accelerates the beam further from 2.5 MeV to 1.0 GeV. The major components of the linac system are the drift-tube linac (DTL), which accelerates the beam from 2.5 MeV to 20 MeV; a coupled-cavity drift-tube linac (CCDTL), which further accelerates the beam to around 93 MeV; and a coupled-cavity linac (CCL), which accelerates the beam to 1.0 GeV. All of the alternative sites would be able to accommodate the linac footprint. The functions of each of the linac components are summarized below.

#### 3.2.1.2.1 Drift-Tube Linac

The DTL is a well-understood structure and has been the workhorse in low-energy accelerators for years. The drift tubes are copper cylinders with a small hole through which the particle beam passes. As the beam passes through the tubes, the particles are subjected to an electric field of rapidly oscillating (402.5-MHz) microwaves. The electric field attracts or repels the particles, depending upon the polarity of the field. The oscillation of the electric field and the length of the drift tubes are such that the particles would be subjected to an accelerating force when they emerge from the end of each tube. The particles enter the next tube before the electric field changes polarity, thus avoiding a deceleration of the particle. The increasing lengths of the drift tubes are calibrated to match the accelerating polarity of the oscillating field, thus providing continued acceleration of the particles throughout the length of the DTL. The drift tubes also contain magnets to ensure the particle beam remains focused (i.e., always accelerating through the center of the drift tubes).

The DTL for the proposed SNS would consist of two sets of drift tubes each housed in a cylindrical tank. The first tank would contain 46 tubes and the second tank would hold 36 drift tubes. The total length of the DTL would be approximately 28.3 ft (8.7 m). The particles would have an energy of 20 MeV as they exit the DTL and enter the CCDTL.

#### **3.2.1.2.2 Coupled-Cavity Drift Tube Linac**

The CCDTL would produce the next stage of energy increase or acceleration of the particles. The CCDTL structure would be optimized to accelerate the beam from 20 MeV to 93 MeV. The CCDTL would be a hybrid structure consisting of a coupled-cavity design into which a drift tube has been added in each cavity to allow for the longer transit time through the cavity. Approximately 40 sections, each consisting of several cavities, would be placed end to end to form a single unit, each with an approximate length of 4.9 ft (1.5 m). Focusing magnets and instruments for analyzing the beam would be installed between these units of the CCDTL. The energy required to accelerate the particles would be 805 MHz rf energy from the klystrons. The total length of the CCDTL structure would be 193 ft (60 m). This portion of the linac would accelerate the particles to an energy of 93 MeV. Particles leaving the CCDTL would enter the CCL.

#### **3.2.1.2.3 Coupled-Cavity Linac**

The CCL would consist of a series of specially shaped cavities. As the particles travel through the accelerator, gaining speed, the cavities would become longer. The accelerator segments would form the basic building blocks for the accelerator. The modules would be mounted on support structures that would allow them to be aligned. Each module would be connected to a

vacuum manifold and a cooling-water system. Magnets for focusing the beam would be located in the drift spaces between segments. Each module would be designed to use the total power output of a single klystron, the cavities being energized by microwaves delivered from the klystrons by waveguides. Upon leaving the CCL, the particle beam would have an energy of 1.0 GeV and would enter the beam transport and ring system.

#### **3.2.1.3 Beam Transport and Ring System**

This part of the accelerator system would function to receive the particle beam from the linac, store it in an accumulator ring, and transport the beam to the target. The beam transport and ring system would contain three major components: the high-energy beam transport (HEBT), the accumulator ring, and the ring-to-target beam transport (RTBT). As described below, these systems are designed to collect large numbers of protons ( $H^+$ ) and deliver them onto the target in a series of short pulses.

The HEBT would carry the fully accelerated beam from the linac to the accumulator ring. The HEBT would contain equipment for beam diagnostics, which would facilitate maintaining the focus of the beam. The configuration of the HEBT would allow the beam to enter the accumulator ring with a minimum of beam loss.

The accumulator ring would receive the beam of  $H^-$  ions from the HEBT. This beam would pass through a thin carbon foil that strips the electrons off the particles, converting them to protons ( $H^+$ ). Magnets in the ring would be used to guide the protons into a beam circulating around the ring. Over 1,200 proton pulses could be accumulated in the ring prior to transfer to the target. The design circumference of the ring

would be 722 ft (220 m). The beam would circulate in a clockwise direction. The energy and focus of the beam would be maintained by magnets, rf energy, and instrumentation. Once a full charge from the linac has been accumulated in the ring, the kicker system would be turned on to direct the beam to the target. The kicker would consist of a series of electromagnets that bend the beam, directing it to the RTBT. The RTBT would take the beam from the accumulator ring to the target located inside the target building.

#### **3.2.1.4 Target and Experiment Building**

The target and experiment stations would be located inside the target building. This section describes the target, moderator system, shutter system, neutron beam guides, beam stops, and experiment stations.

##### **3.2.1.4.1 Target**

The high-energy protons from the accumulator ring would be directed through the RTBT to the target. Upon hitting the target, the protons would cause neutrons within the nuclei of the target material to be ejected as the heavy metal molecules release excess impact energy. Heavy metals provide the most effective source of neutrons for the spallation process because of the high neutron-to-proton ratios. Target materials used at existing spallation neutron sources include uranium, tungsten, and tantalum. However, at proton beam powers above 1 MW, problems from thermal shock would arise while cooling a target made of solid materials. As a result, these solid targets would have a short life span and would require frequent replacement, thereby greatly increasing the amount of radioactive waste generated by the facility. The proposed SNS would use liquid mercury as the

target material. The mercury target would have the following advantages over a solid target:

- Mercury, being a liquid, is not as susceptible to thermal shock stresses. Therefore, mercury target material would last for the entire 40-year life span of the proposed SNS.
- The mercury in the target would not be consumed or need to be replaced during the life of the facility. Therefore, much less radioactive waste would be generated than would result from a series of solid targets.
- A liquid target has higher yields of neutron production at higher powers.
- Mercury would be circulated in and through a stainless steel target vessel, thus increasing the thermal mass of the mercury target and facilitating the cooling process. Cooling water would be circulated through the target structure and a heat exchanger to remove heat. This cooling water is isolated from the mercury within the target vessel.

Approximately 35.3 ft<sup>3</sup> (1 m<sup>3</sup>) of mercury would be needed for the proposed SNS target and would be contained in the target vessel and associated heat exchangers. Several layers of containment would be designed into the target assembly. At the point of beam impact, the mercury would circulate inside a rectangular, double-walled chamber (Figure 3.2.1.4.1-1) with cooling water in the outer annulus space and helium in the inner space. The helium chamber would isolate the mercury from the water and provide a leak detection mechanism in the event of partial vessel failure. If the target vessel components begin to fail, the helium layer would help isolate the mercury from the water. If the entire assembly should fail, the mercury and water would be contained in a 71-ft<sup>3</sup> (2-m<sup>3</sup>) shielded vessel below the target assembly. (See

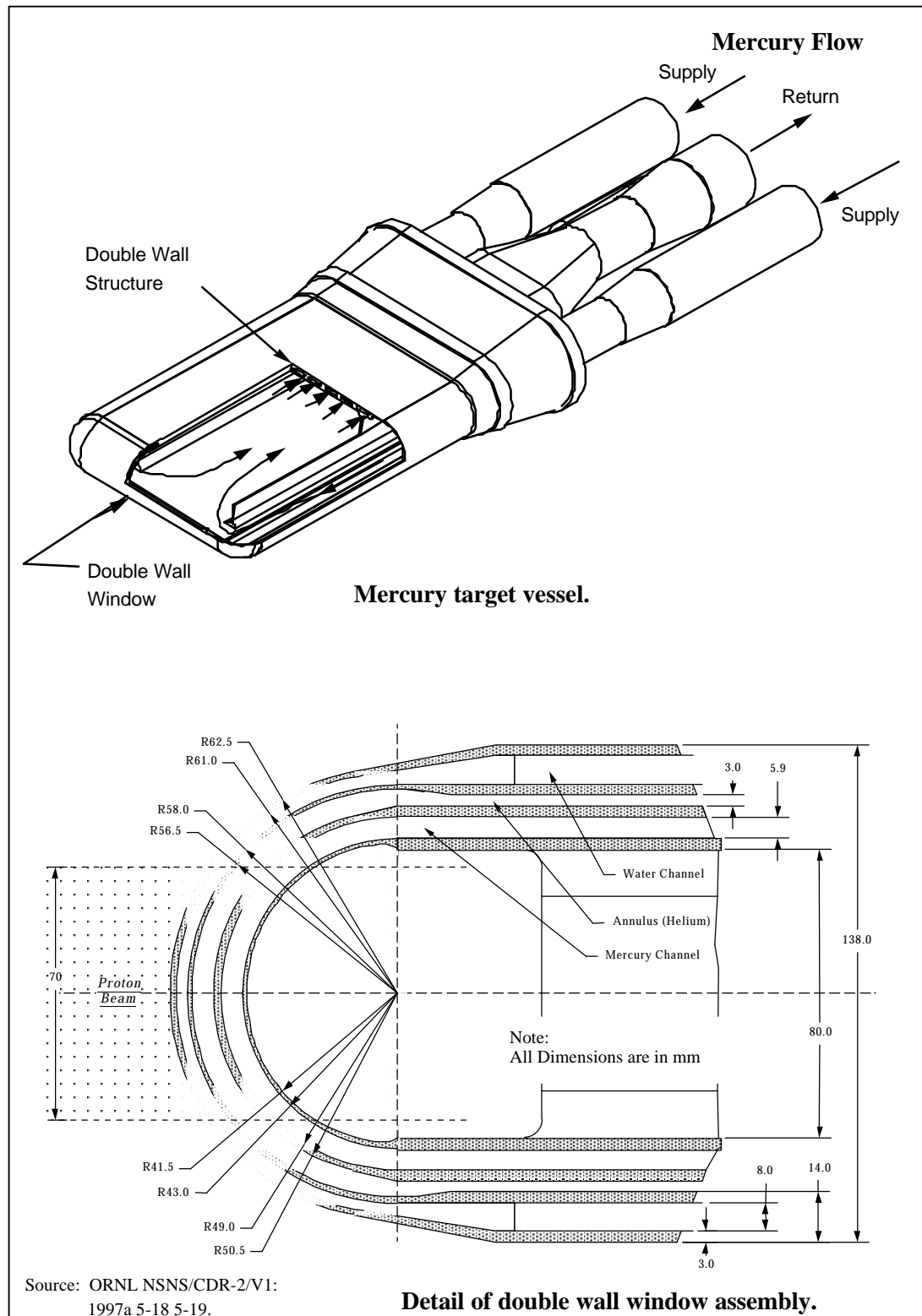


Figure 3.2.1.4.1-1. Mercury target vessel.



Appendix C for a description of postulated accidents at the proposed SNS.)

The target assembly would be constructed on a mobile cart system housed in a heavily shielded structure. The target cart would be designed to support all of the mercury- and water-circulating equipment and would provide a means of transporting the target to the hot cell area for maintenance. The target hot cell, located behind the target assembly's normal operating position, would be shielded and equipped to allow for remote handling of the target during maintenance.

Two collection and storage tanks would be located below the floor of the target hot cell. Both tanks would be shielded and self-cooled. One of these tanks, the spill tank, would have open, gravity-feed connections to the target vessel, target hot cell floor, and mercury processing equipment. This tank would contain the mercury and water in the event of equipment failure or spill. The other tank, the mercury storage tank, would be used to temporarily store the mercury during maintenance operations.

Maintenance operations would include replacement of the target window. The proton beam travels through this window to impinge on the mercury. Although the window is made of stainless steel, the proton beam would deteriorate this window over time, requiring replacement. Other maintenance activities would include servicing the pumps that circulate the mercury, replacing vacuum seals, and performing routine inspections. During maintenance activities, the mercury would be drained into the shielded mercury storage tank. The mercury would not be removed from the target hot cell.

#### 3.2.1.4.2 Moderator Systems

Neutrons emitted directly from the target assembly would be traveling too fast to be useful in neutron scattering experiments. Moderators would be designed to slow the neutrons in order to optimize their interactions with the materials being studied. Neutrons are slowed in a moderator by transferring part of their energy to the moderator through their successive collisions with moderator molecules. The energy gained by the moderator material is in the form of heat that is transferred to a cooling system.

The proposed SNS would have two types of moderators. Ambient-temperature water moderators would use deionized water maintained at a temperature below 86°F (30°C). Cryogenic moderators would use liquid hydrogen to maintain a temperature between 16 and 25°K (-430.6 and -414.4°F; -257 and -248°C). The hydrogen would be contained in a continuous, inert blanket of helium. This safety measure would provide insulation of the hydrogen from atmospheric air and prevent air from entering the moderator systems.

#### 3.2.1.4.3 Shutter System

Shielding shutters would be installed on each of the neutron beam lines. The shutters would be used to interrupt the neutron beam to allow samples to be removed or inserted into individual experimental chambers while the overall spallation source is operational. The shutters would be massive structures made of tungsten. The shutters would provide 6.6 ft (2 m) of shielding and would be approximately 13.1 ft (4 m) in height. Each would weigh approximately 16 tons and would be moved by an electric-motor-powered screw drive. When open, the shutters would permit the flow of

neutrons through the beam guides to the experiment stations.

#### **3.2.1.4.4 Neutron Beam Guides**

The neutrons would be guided to the experiment stations through beam guides. These guides would be shielded tubes that conduct the moderated neutrons beyond the bulk shielding of the target assembly to the experiment stations containing neutron detection instrumentation. A target system building would have a maximum of 18 beam guides, 9 from each moderator set (thermal and cold).

#### **3.2.1.4.5 Beam Stops**

Beam stops are engineered structures designed to receive the beam whenever circumstances require the beam to be diverted from the target station or the accumulator ring. These large masses of steel and concrete would absorb the beam energy and would shield the staff and the environment from any residual radiation. Beam stops would be constructed at strategic locations along the beam path where they would be available for use in emergency situations (such as downstream equipment failure) or as a beam tuning tool for upstream system testing.

#### **3.2.1.4.6 Target and Experiment Building**

The proposed SNS initially would have one target providing 60 pulses of neutrons every second. A second target that would provide 10 to 20 pulses of neutrons every second is a potential future upgrade (Section 3.2.1.5). Each of these targets would be contained in a separate target building, providing the planned total of 36 neutron beams. Each target building would contain an experiment hall and experiment support buildings. All the instrumentation for conducting neutron scattering experiments

would be constructed in the experiment support buildings. Most of the neutron detection instruments would fit entirely within the associated experiment halls. However, a few long-flight-path instruments would be on neutron beam lines that extend through the walls of the experiment halls (refer to Figure 1.3-1).

#### **3.2.1.5 Future Upgrade Options**

A recommendation in the Basic Energy Sciences Advisory Committee (BESAC) reports has been to build into the original design a clear upgrade capability to higher-power operation. This has played a key role in selection of technology, as well as in the layout and configuration of the baseline 1-MW design. The decision of whether or not to upgrade the facility would be made after the 1-MW facility is operational. In anticipation of the decision to upgrade the SNS, the facility would be constructed in stages. Only one of the target stations (60 Hz) would be included in the first construction stage. The baseline project includes only the first 10 neutron beam lines, instrumentation, and support equipment. They would be installed and ready for commissioning at the time the source becomes operable. A scientific program could begin within a few months after startup.

It is expected that additional instruments would be installed at the rate of one or two per year to fill the first target building. Thus, all the available neutron scattering beams on the first target station would be expected to be occupied by operational instruments within approximately five years after the source begins operating. At that time in the future when the second target station is proposed, several of the existing neutron scattering instruments would be moved from the first target station to the second, where they could operate even more effectively. The fully upgraded SNS facility would have 4 MW

of beam power available for two target stations, one optimized for operation at approximately 60 Hz and the other at approximately 10 Hz. Achieving 4 MW would require building a second front end system and a second accumulator ring. Each set would then be capable of delivering beams suitable for 2-MW operation. Figure 3.2.1.5-1 shows a site plan for the proposed SNS as it would look when fully upgraded at a future time.

#### **3.2.1.5.1 Second Target Station**

A high priority for the user community would be the addition of a second target station to increase experimental flexibility and to accommodate additional instruments. Target station optimization is influenced by the pulse repetition rate required for a specific research experiment.

The first target station would be optimized for a repetition rate of approximately 60 Hz. The second target station would allow an instrument group to be optimized at a lower beam repetition rate in the range of 10 to 20 Hz. No technical challenges have been identified that must be resolved before adding the second target building. Plans for upgrading the facility would be designed such that no interruption in user programs would last for more than six months.

The second target building would be built adjacent to the first target building (refer to Figure 3.2.1.5-1). For cost savings, structural design in the first hall could be duplicated. A crossover beam line would be built, and a switching magnet would be added to the first RTBT to send pulses to the second station.

#### **3.2.1.5.2 Upgrade from 1 MW to 2 MW**

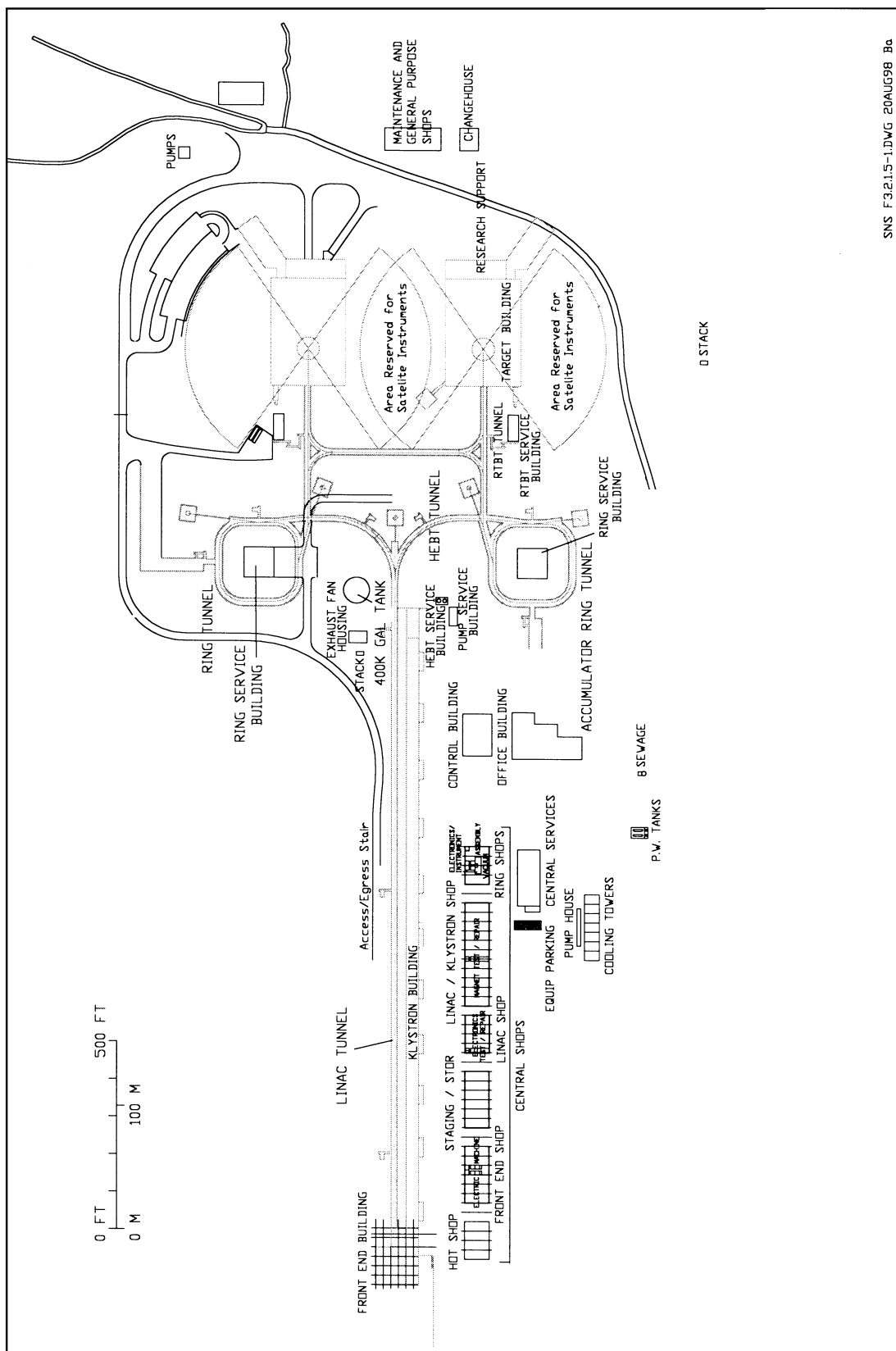
An inherent feature of the baseline 1-MW design would be the relative ease in reaching the 2-MW level of performance. In general, this upgrade would consist of increasing the output of the ion source and upgrading the power systems of the linac. The overall footprint of the facility [the 110 acres (45 ha) encompassing the buildings and associated support facilities] would not change. Table 3.2.1.5.2-1 summarizes what would be involved in this upgrade.

The specifications for beam loss for the proposed SNS would be very strict to avoid excessive activation of components. Maintenance of the strict beam-loss specifications at the higher current level would be a challenge, but incrementally increasing the beam current and resolving beam loss problems as they occur would result in an overall increase in performance.

#### **3.2.1.5.3 Upgrade from 2 MW to 4 MW**

The second stage of power upgrade would require more significant expansion of accelerator capabilities. The requirements are summarized in Table 3.2.1.5.3-1.

The upgrade would consist of constructing a second front end and a second accumulator ring. The second front end would be housed in the same building as the first front end. The second accumulator ring would be constructed on the other side of the linac, mirroring the first ring (refer to Figure 3.2.1.5-1). The rings would be connected to the two target buildings with RTBTs that would allow the operators to direct the beam from either ring to either target. To reach maximum beam power, the particles in both rings would be directed to one target.



SNS F3.2.1.5-1.DWG 20AUG98 Bq

Figure 3.2.1.5-1. Site plan for fully upgraded facility.

**Table 3.2.1.5.2-1. Requirements for upgrade to 2-MW beam power on target.**

Proposed SNS Component	Requirements
Ion source	The current of the ion source (front end) would be doubled to 70 mA. The ion source would have to be engineered to dissipate the increase in thermal loading at 70 mA, as compared to 35 mA.
LEBT and RFQ	No changes. Designed to handle the increased beam power.
Linac	All of the components installed for 1-MW operations would be designed to deliver a beam power of 2-MW on target. Some of the linac power and support systems would be upgraded.
MEBT, HEBT, accumulator ring, and RTBT	No changes. Components installed for 1-MW operations would be designed to produce a beam power of 2 MW on target.
Beam chopper	May require enhancement in performance, particularly to ensure that specifications of the chopper gap are met.
Klystrons	Additional 12 klystrons required. The rf waveguides, feeds, and coupling between the CCDTL and CCL modules would be redistributed.
Target	An increase in beam power on target would require an improved target design and an upgrade of the target cooling system. Technical improvements indicated by lower-power operations would be incorporated.
Balance of proposed SNS facilities	Power distribution and cooling system capacities would be upgraded. The initial design would include sufficient space for these upgrades.

**Table 3.2.1.5.3-1. Requirements for upgrade to 4-MW beam power on target.**

Proposed SNS Component	Requirements
Ion Source, LEBT, RFQ, and MEBT	Duplicate all components by constructing a second front end capable of 70 mA. A funnel would be needed to combine the two front end beams into one beam for the linac injection.
Linac	Add 14 additional klystrons. The rf waveguides, feeds, and coupling between the CCDTL and CCL modules would be redistributed.
HEBT	Construct a second HEBT from the linac to the second accumulator ring.
Accumulator ring	Construct a second accumulator ring capable of handling a 2-MW beam. Crossover beam transports would also be constructed.
RTBT	Construct an additional RTBT to connect the new accumulator ring to the targets.
Beam Chopper	May require enhancement in performance, particularly to ensure that specifications of the chopper gap would be met.
Target	No changes. The mercury target would be designed to handle 4 MW of beam power. The capacity of the target cooling system would be increased.
Balance of proposed SNS Facilities	Power distribution and cooling system capacities would be upgraded. The initial design would include sufficient space for these upgrades.

### 3.2.2 CONSTRUCTION

This section of the FEIS provides a description of the activities that may be required to construct the proposed SNS, with specific activities depending on individual site requirements. In addition to outlining site preparation and construction of various facilities and systems, it includes the projected size of the construction workforce, worker safety during construction, construction traffic levels, and generation of waste through construction activities. Figure 3.2.2-1 outlines the proposed project schedule by phases of construction and operation.

#### 3.2.2.1 Workforce

During the first year of construction (FY 2000), only 35 out of the 166 full-time design and construction employees on the proposed SNS project nationwide would be dedicated to construction (refer to Figure 3.2.2-1). In the third year (currently scheduled for FY 2002), full-time project employees would peak at 578, of which 480 would be dedicated to construction. Prior to construction completion in the fifth year (currently scheduled for FY 2004), the full-time project employees would decrease to 313, including 110 construction workers (Brown 1998a).

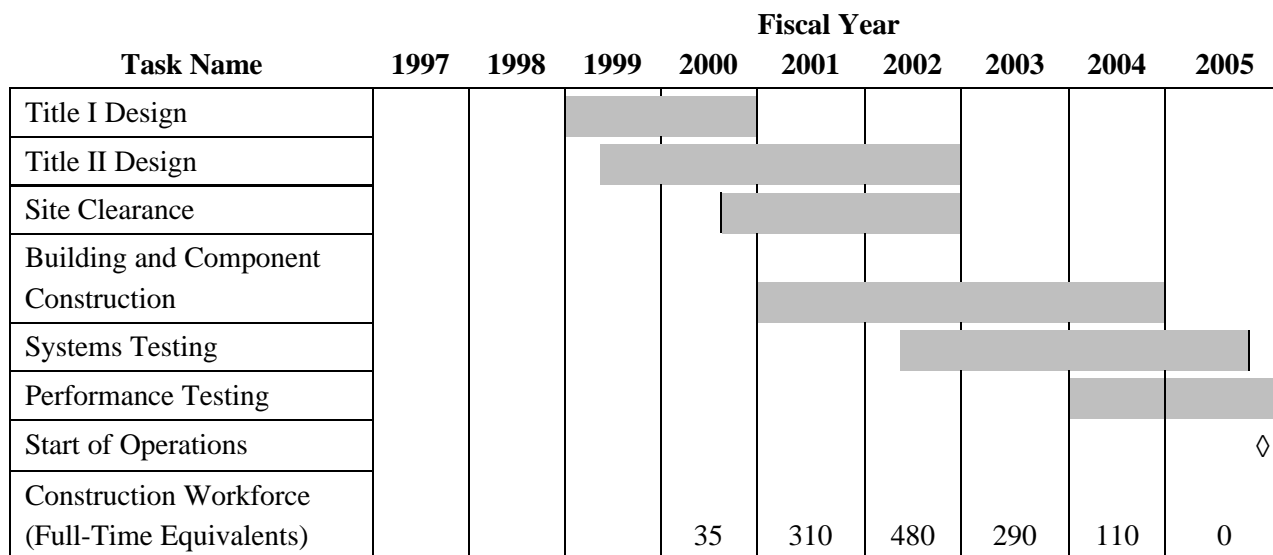
#### 3.2.2.2 Traffic

Most of the vehicular traffic related to construction of the proposed SNS would be created by construction managers and workers, suppliers of construction materials, and service providers. Table 3.2.2.2-1 summarizes the type and number of vehicles for each category. A significantly smaller amount of traffic would consist of intermittent site inspection visits by personnel from DOE, the host laboratory

contractor, design laboratories/contractors, and others with an interest in the conduct of operations at the construction site. This traffic would consist of vehicular movement confined to construction areas and vehicular movement between the proposed SNS construction areas and points outside of these areas.

Traffic between points inside construction areas would be a direct function of specific construction demands. This traffic would consist almost entirely of frequent, short distance trips by earthmoving equipment such as bulldozers, backhoes, heavy trucks, and light trucks.

The heaviest daily traffic would consist of round-trip vehicular movement between the proposed SNS construction areas and outside points. This traffic would consist of commuting by construction managers and workers, movement of heavy trucks between construction areas and off-site facilities (such as borrow areas), visits by supply trucks and service providers, and intermittent business-related visits. Table 3.2.2.2-2 presents a conservative estimate of the number of truck trips to the site during construction. These materials correlate with the construction activities described in Section 3.2.2. Traffic would begin at relatively low levels with the onset of physical construction activities in the second year (FY 2000) and would increase to its maximum in the third (FY 2001) and fourth (FY 2002) years, the peak construction years for the proposed SNS. During this time, worker commutes would constitute a maximum of about 466 daily round trips to the proposed SNS construction areas; material transport would add 7 daily round trips and service providers would add an additional 3 daily round trips.



**Figure 3.2.2-1. Proposed SNS summary schedule for design and construction.**

**Table 3.2.2.2-1. Construction traffic.**

Activity	Vehicle	Daily Round Trips
Managers/workers	Passenger	466/dy <sup>1</sup>
Material transport	Truck	7/dy <sup>2</sup>
Service providers	Truck	3/dy <sup>3</sup>
Total		476

<sup>1</sup>Based on Tables 5.2.10.1-2, 5.3.10.1-1, 5.4.10.1-2, and 5.5.10.1-1.

<sup>2</sup>Value calculated per Table 3.2.2.2-2.

<sup>3</sup>Best professional judgement.

**Table 3.2.2.2-2. Construction truck material shipments.**

Material	Number of Trucks
Concrete (Sect. 3.2.2.4)	2,250
Steel (Sect. 3.2.2.4)	200
Crushed stone for UNAC (Sect. 3.2.2.9)	1,278
Temporary employee parking (Sect. 3.2.2.6)	361
Permanent employee parking (Sect. 3.2.2.6)	48
4 miles of paved roads (Sect. 3.2.2.6)	3,911
Sanitary waste during construction (Sect. 3.2.2.11)	468
Total trucks during construction	8,516
8,516 ÷ 5 yr construction = 1,703 trucks per yr	
1,703 trucks per yr ÷ 250 workdays per yr = 7 truck round trips per workday.	

This level of traffic would diminish with the decrease in construction activities between FY 2002 and FY 2004.

### 3.2.2.3 Site Preparation

The central buildings and systems of the proposed SNS would be constructed within a hammer-shaped footprint of approximately 110 acres (45 ha) (ORNL 1997b: 8-1). This area would accommodate the fully upgraded facility. During construction of the 1-MW facility, the land not needed for the construction of facilities would be used as a lay-down area and as temporary parking lots for construction workers.

Construction of the proposed SNS would start with site preparation and grading activities. These activities would begin with the removal of existing vegetation in specific areas designated for construction and construction-support operations. Where possible, natural vegetation on or adjacent to the site would be preserved and protected (ORNL 1997b: 8-30).

Construction locations within the site would be graded and backfilled using heavy equipment. Earth-moving would be performed in accordance with DOE Standard Specification CV-1.3 (ORNL 1997b: 8-30). Laydown areas for construction materials and areas for temporary construction facilities would be created (ORNL 1997b: 8-30).

All topsoil would be scraped and stockpiled in a designated location for on-site landscaping and revegetation efforts. Any excess topsoil would be stockpiled and preserved for future use. To the extent possible, maintainable slopes would be used at all changes in elevation. Newly graded slopes over 3:1 (three units horizontal to one unit vertical) would be considered for retaining walls, soil stabilization, and

maintenance-free landscaping. Appropriate provisions would be made for the disposal of rock and other excavated debris. On-site burying of debris would be prohibited (ORNL 1997b: 8-30).

The removal of vegetation and the loosening of soils during site preparation could enhance the potential for soil erosion and transport to surface water bodies during periods of precipitation. Permanent and temporary erosion-control measures would be used at the earliest feasible times to minimize such effects. Temporary stormwater management and silt retention facilities, such as silt fences, would be provided where early placement of permanent improvements would be impractical. As soon as possible, denuded and disturbed areas would be revegetated with appropriate native plant species to minimize erosion and downstream siltation. Cut-and-fill slopes would be sufficiently stabilized by mechanical methods or planting vegetation to prevent failure and erosion (ORNL 1997b: 8-30).

A permanent retention basin would be constructed as part of the overall runoff control to mitigate the amount of sediment loading to receiving streams. The basin would also serve to equalize the flow of water to the receiving stream. At the conceptual design stage, the size of the retention basin required is estimated at approximately 2 acres (0.81 ha).

### 3.2.2.4 Construction Materials

Based on the conceptual design, approximately 50,000 yd<sup>3</sup> (38,228 m<sup>3</sup>) of concrete and 4,000 tons of steel would be used for construction of the proposed SNS and for shielding. At this time, estimates of other building materials are not available.



Concrete and steel shielding blocks may be available from existing DOE facilities. For example, concrete and steel shielding blocks may be available from the decommissioning of the Bevatron facility at the Lawrence Berkeley National Laboratory (LBNL). In addition, recycled steel from other DOE facilities may be available. Concrete and steel from these sources may be slightly radioactive. Reuse of slightly contaminated material was established as waste minimization policy by DOE. If DOE decides it is feasible to use the concrete and steel blocks in the proposed SNS, an assessment of the potential radiation doses to workers and the general public would be made prior to transporting the material to the proposed SNS site.

### **3.2.2.5 Utilities**

Utility construction would extend electricity, telephone/data communications, natural gas, potable water, and sanitary sewer service to the proposed SNS facilities (ORNL 1997b: 8-34). Where possible, these services would be extended from the points where existing sources of sufficient quantity and capacity make their nearest approaches to the proposed SNS site. Doing this would limit the total area of land that would be disturbed by new utility construction.

The extension of utility services into the proposed SNS site would entail vegetation clearing throughout the utility corridors. With respect to overhead electricity and telephone/data communications lines, vegetation removal would focus primarily on trees where forested areas intersect the transmission line corridors. Ground cover and understory vegetation would be cleared for the laying of pipelines and sanitary sewage lines, since these components require the excavation of pits and

trenches. Some shallow soil excavation and augering would be necessary to extend electrical service to the proposed SNS site. Activities would involve the setting of utility poles, transmission line towers, and other such components of overhead utility systems.

### **3.2.2.6 Roads and Parking Lots**

A system of roads and parking lots would be constructed on the proposed SNS site. These would be both temporary and permanent. Temporary roads and parking lots (dirt and gravel) would be established at the beginning of construction activities to provide construction vehicles with ease of access to and among the various on-site construction locations. Where feasible, the locations of temporary roads and parking lots would coincide with planned roadways and parking lots or planned construction areas, to minimize zones of disturbance on the site (ORNL 1997b: 8-28). Temporary parking lots would be provided for construction vehicles (ORNL 1997b: 8-34). If necessary, temporary parking could be established a short distance from the construction site, with buses transporting the workers. By the end of construction, 4 miles (6.4 km) of permanent, paved roads and parking areas for 250 persons would be constructed. On a site-specific basis, additional construction and improvement of permanent, paved roads would be necessary to effectively connect the on-site roads and parking lots with the system of existing roads in the vicinity of the proposed SNS site. Permanent roads and parking lots would be subject to finish grading; excavation of trenches for drainage features, such as concrete curbs and guttering; paving; and the painting of paved surfaces with traffic control symbols and parking lines (ORNL 1997b: 8-29).

### 3.2.2.7 Stormwater Drainage System

A stormwater drainage system would be constructed for the proposed SNS site. The stormwater drainage system would collect, detain, carry, and discharge stormwater runoff from the site so that water neither interferes with the safe operation and maintenance of the proposed SNS facilities nor causes erosion or other damage to natural or man-made features of the site (ORNL 1997b: 8-30). The system would include the drainage of newly constructed and improved roads connecting the proposed SNS site to existing roads. It would consist of contoured landforms and a system of subsurface pipes, junction boxes, and culverts to route stormwater to a retention basin. The retention basin would have sufficient capacity for a 100-year, 24-hour design storm. The system would mitigate the effects of excess runoff on downstream systems and would be monitored as required (ORNL 1997b: 8-30).

### 3.2.2.8 Proposed SNS Facilities

Temporary and permanent facilities would be constructed by the proposed SNS project. The temporary facilities would be established to support construction of the permanent proposed SNS facilities. The following types of temporary support facilities may be needed during construction of the proposed SNS (ORNL 1997b: 8-33 and 8-34):

- Storage, staging, and laydown areas for pipe, reinforced concrete, steel, cabling, conduit, rebar, fuel, and other construction materials.
- Shops, sheds, and test laboratories.
- Concrete batch plant and its aggregate stockpiles.
- Containment for aggregate stockpile runoff.

- Spoil disposal areas.
- Stockpile areas for excavated soil and rock.
- Borrow areas.
- Construction offices.
- Waste concrete disposal facility.
- Truck wash.
- Toilet facilities.
- Class IV landfill for disposal of construction debris.
- Facility to receive sanitary waste.

Most of these facilities would be established within the 110-acre (45-ha) proposed SNS footprint. However, borrow areas, stockpile areas for excavated soil and rock, spoil disposal areas, and a landfill for construction debris could be at off-site locations in the vicinity of the proposed SNS site.

To minimize the footprint area, all temporary facilities on the proposed SNS site would be located within areas subject to disturbance by site preparation activities. Facilities not slated for reuse as permanent facilities would be removed from the proposed SNS site when they are no longer needed. Construction of the temporary facilities would result in the generation of spoil, construction debris, and possibly other types of waste, which would be managed in accordance with the requirements identified in Section 3.2.2.11. Whenever practical, some facilities initially required for temporary use would be located and constructed with the potential to be reused as permanent shop or warehouse space. Construction would be in accordance with appropriate requirements in the Uniform Building Code (ORNL 1997b: 8-33 and 8-34).

Earth fill for the proposed SNS site would be obtained from off-site borrow areas. This fill would consist of excavated soil or excavated soil

mixed with rock and would meet engineering requirements for foundation support and settling parameters. Borrow areas would be selected to minimize travel distances to the proposed SNS site.

Temporary security fencing would be erected around the construction site. This fencing would protect construction equipment and building materials. In addition, it would control access during construction and restrict vehicular traffic to authorized roads (ORNL 1997b: 8-34). This barrier would also limit the total area of land disturbed by construction activities.

The construction and use of several temporary facilities would involve minor discharges. Operation of the concrete batch plant would entail some water discharges. Operation of the truck wash facility would result in short-term discharges of wash and rinse waters, possibly containing small amounts of oil and other hydrocarbons. Construction wastewater would be collected in tank trucks and transported to appropriate waste management facilities for treatment. Thus, pollutant discharges to soil, surface water, and groundwater would be minimized.

The fuel storage facility would be equipped with sufficient secondary containment to prevent spills to the environment. Any releases from wash or fuel storage facilities would be pumped to tanks for transport to the local process water treatment facility. No release to local drainages would be permitted.

Permanent facilities on the proposed SNS site would consist of major buildings and several ancillary structures. Buildings would house the accelerator equipment and instrumentation, described in Section 3.2.1, that comprise the

proposed SNS, as well as the support systems, laboratories, and offices necessary for its safe and effective operation. Ancillary structures would support the proposed SNS operations in the buildings, prevent soil erosion, provide structural support for equipment, and bolster site security. These structures would include cooling towers, an electrical substation, foundation pads for transformers, a fire water tank, retaining walls, fencing, and security inspector posts.

Fifteen permanent buildings would be constructed on the proposed SNS site for the 1-MW facility. These buildings would cover more than 6 acres (2.43 ha) of land within the 110-acre (45-ha) proposed SNS footprint. The constructed floor space in these buildings would be nearly 364,942 ft<sup>2</sup> (33,903 m<sup>2</sup>) (ORNL 1997b: 8-1). The buildings that would be constructed, the major equipment that would be assembled within them, and their designed interior areas are listed in Table 3.2.2.8-1. Duplicates of existing buildings, such as the Target Building, would be constructed in association with later upgrades to an operating power of 4 MW (see Section 3.2.1.5). Refer to Figures 3.2.1-1 and 3.2.1.5-1 for the building layout.

Construction of the permanent buildings and ancillary structures would begin with excavations for building foundations, ancillary structure foundations/support pads, and retaining walls. These excavations would be performed with heavy equipment. Completion of the proposed SNS buildings would proceed as a standard construction project, except for the possible inclusion of slightly radioactive steel and concrete materials in the beam line tunnel buildings (refer to Section 3.2.2.4). These buildings would be constructed to resist natural

**Table 3.2.2.8-1. Buildings to be constructed for the proposed SNS.**

<b>Building</b>	<b>Equipment Summary and Function</b>	<b>Size (ft<sup>2</sup>)</b>
Front End	Ion source; LEBT, RFQ, and MEBT; vacuum system, power supplies, cooling and service system storage, local control room.	18,345
Linac Tunnel	Linac structure; power, electrical, cooling, and service distribution systems; access towers.	23,778
Klystron Gallery	Klystrons, modulators, and rf power systems; magnet power systems; HVAC systems; waveguides to linac; 4 capacitor rooms.	54,810
HEBT Tunnel	HEBT structures; power, electrical, and service distribution systems.	9,255
Ring Tunnel	Ring structures; power, electrical, and service distribution systems.	14,482
RTBT	RTBT structures; power, electrical, and service distribution systems.	8,672
Target	Target, target moderator systems, shielding, target maintenance cell, experiment systems; electrical, cooling, and service systems for target, moderators, and experiment systems; waste collection systems; shops, equipment rooms, laboratories, and offices to support research instruments and activities. Compressor area.	120,565
Ring Service	Power supplies (including rf), electrical systems, cooling systems, vacuum systems, and HVAC systems.	7,500
RTBT Service	Power supplies, electrical systems, cooling systems, vacuum systems, and HVAC systems.	1,960
Beam Stop Service	Target, shielding, electrical, and service systems.	6,240
Central Utilities	Deionized cooling water system, chilled water system, compressed air, and heat exchangers.	9,000
Central Shop	Machine shop, storage, electrical shop, office space, shielded decay area, test and repair shops for klystrons and magnets, electronic equipment, vacuum systems and equipment, and tools and parts storage. Hot shop.	64,500
Integrated Control	Integrated control room, electrical and mechanical support equipment, service systems for control room, office and storage space to support control room activities.	8,660
Administration	Office and support space for operating personnel.	17,175
Site (miscellaneous foundations, pads, etc.)	Tank, transformer, pumps, switchyard, diesel generators, etc. Foundations, pads and structural features.	NA*

\*NA – Not available.

phenomena such as earthquakes, wind, and flooding (ORNL 1997b: 8-40). Construction of the proposed SNS buildings would include the erection of structural support members and construction of the soil shielding berms (refer to Section 3.2.2.9). In addition, it would include the installation of utility, communications, environmental control, mechanical, data management, safety, fire protection, and waste system components. Construction would be completed with the finish and trim work and final installation of the accelerator equipment, controls, and instrumentation.

Erection of the ancillary structures would begin with the laying of foundations, support pads, and retaining walls. Completion of the ancillary structures would entail the erection of the cooling towers, electrical substation, security inspector posts, and permanent fencing. In addition, it would include the installation of transformers on their foundation pads.

### **3.2.2.9 Exterior Shielding Design**

The conceptual design of the proposed SNS has exterior shielding to protect the environment from ionizing radiation. The beam line tunnels (linac, HEBT, rings, RTBT, and beam stops) would be backfilled with a soil cover contoured to match the natural slope (Figure 3.2.2.9-1). The thickness of the berm would be approximately 26 ft (7.9 m). The shielding calculations done by ORNL were for a representative soil type and were not site-specific. No significant differences are expected in the shielding properties of soils at different sites.

This berm would be constructed from fill set aside during excavation (with additional soil

from a local borrow area, if needed). A diversion trench would carry any surface runoff away from the facility and the berm. A water-diverting barrier would be placed just below the surface of the soil berm to repel water from infiltration. A groundwater interceptor system would be constructed under the tunnel building. It would capture any groundwater that might breach the barrier and hold it for sampling within a leak-proof collection system. Foundation drains would be incorporated into the system. The system would be connected to the site's stormwater drainage system to allow the release of uncontaminated water. Other connections would allow transport of contaminated water to appropriate waste systems for treatment (ORNL 1997b: 8-31).

Beam loss is a term used to describe particles that escape the beam. These accelerated particles travel through the surrounding material. Many of them end up in the soil berm surrounding the linac tunnel. These particles would interact with the molecules in the soil, causing "activation" or the creation of slightly radioactive molecules within the soil. The soils nearest the tunnel would contain approximately 99.95 percent of radionuclides within the first 13 ft (4 m) of soil in the berm. At decommissioning, soils adjacent to the tunnel would constitute a radioactive source term that may require mitigation or monitoring.

Construction of the proposed SNS would incorporate features into the design of the berm shield (Figure 3.2.2.9-2) to protect against infiltration of groundwater and migration of radionuclides. The linac tunnel would be covered with an impermeable clay material (obtained by compaction of native soils possessing a high clay content).

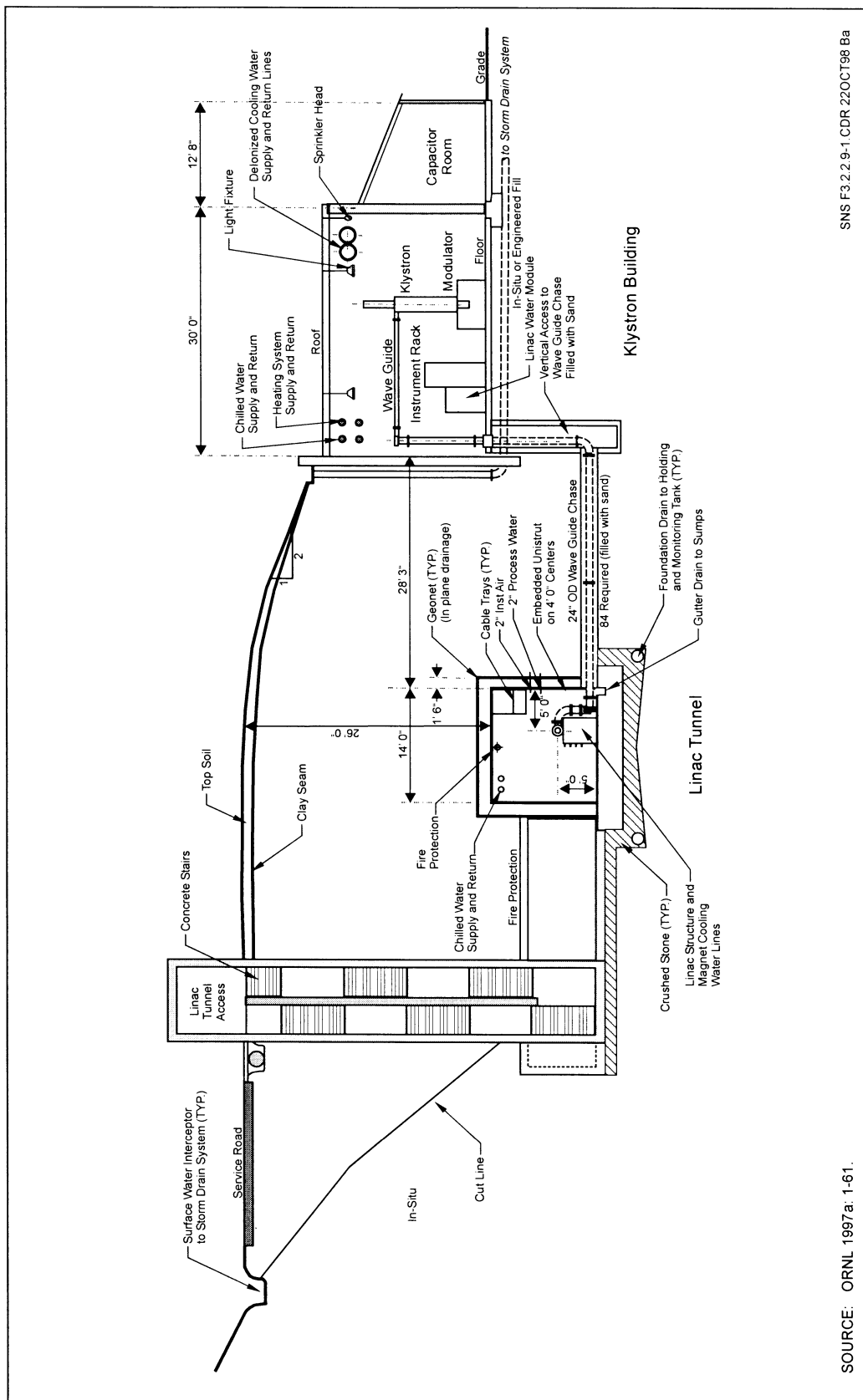
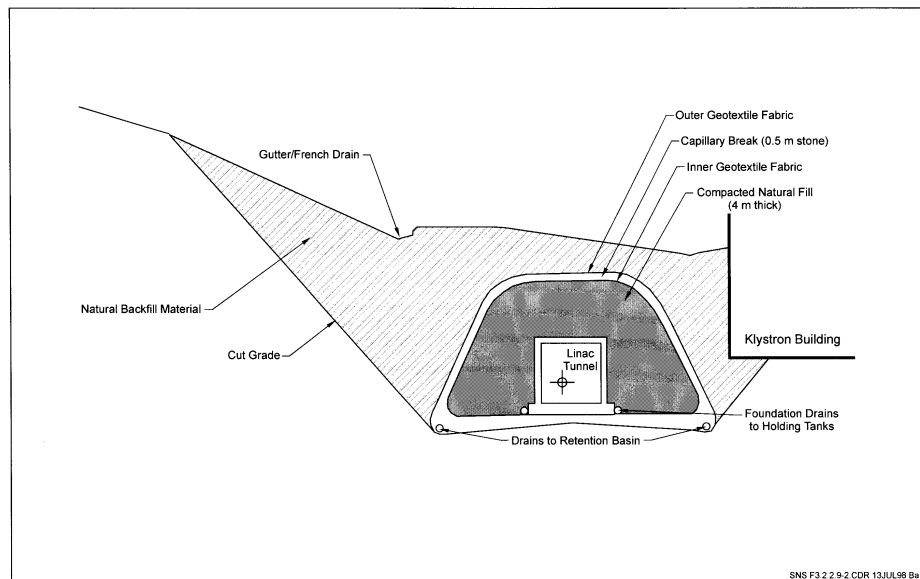


Figure 3.2.2.9-1. Detail of linac tunnel and shielding berm.



**Figure 3.2.2.9-2. Linac berm shield.**

The clay layer would then be backfilled with native soils, and the surface would be contoured to a natural slope. Foundation drains would be placed at the base of the linac tunnel to capture any infiltrating water that might by-pass the impermeable clay layer. These drains would channel this water into holding tanks for monitoring and proper disposal.

If, after the site for the proposed SNS is selected, site characterization shows that further mitigation would be necessary to prevent radionuclides from reaching the groundwater, the berm design would include a capillary break, a layer of crushed stone approximately 1.5 ft (0.5 m) thick placed between the clay layer and the native soils. The stronger capillary attraction of the finer-grained native soils would divert infiltrating groundwater away from the compacted clay materials. Drains at the base of the capillary break would carry diverted water to a retention basin for later discharge. To

maintain its effectiveness, a porous but fine-mesh geotextile fabric membrane would be placed above and below the crushed stone to prevent the migration of soil particles into the stone interval. The capillary break would provide redundant protection to the impermeable clay layer permitting the shield materials and the tunnel structures to remain dry, thereby eliminating a mechanism for nuclide transport.

### **3.2.2.10 Landscaping**

The proposed SNS site would be landscaped during the construction phase of the project. The landscaping would primarily involve the finishing of on-site landforms and the revegetation of cleared areas. This activity would simultaneously establish the final erosion control measures for the site and promote a variety of desirable aesthetic and environmental conditions (ORNL 1997b: 8-27).

The landscaping techniques, final landforms, and revegetation activities would be chosen to promote the recovery of natural resources disturbed during construction. For example, natural flora in unlandscaped areas would be reestablished and proper selection of final land contours and cover vegetation would prevent the erosion of topsoil. Landscape elements would be selected to enhance the diversity of native wildlife on the proposed SNS site. They would give prominence to attractive site features and de-emphasize or obscure less desirable features (parking areas, loading docks, and storage areas) and would provide visual buffers between security zones. Where feasible, trees would be used as elements of energy conservation for the proposed SNS buildings and for on-site control of noise. Where appropriate, open areas would be developed as environmental research zones (ORNL 1997b: 8-32).

Geotechnical systems, rip-rap, or other appropriate landscaping materials would be used in the construction of retaining walls to avoid the negative visual effect of massive retaining structures. Retaining walls that are part of buildings would be integrated structurally with the requirements of the groundwater interceptor system (ORNL 1997b: 8-31).

### **3.2.2.11 Waste Generation**

The site preparation and excavation activities at the proposed SNS site could result in excess quantities of excavated material consisting of soil and rock. (ORNL 1997b: 8-33). None of this spoil material would be hazardous or radioactive waste. That portion of spoils material that could not be used on-site would be disposed of at a nearby borrow area. The disposed materials would be spread and compacted at the disposal area to maintain current drainage patterns. Construction materials

waste would not be disposed of at this facility (ORNL 1997b: 8-33), but at a permitted construction debris landfill in accordance with current procedures at the selected site.

Nonradioactive and nonhazardous construction debris would be shipped to a permitted disposal site. This waste would consist of nonrecyclable excess materials (i.e., wood, drywall, and masonry) from facility construction and the demolition of temporary facilities. Any similar waste materials from the operation of temporary shops and test laboratories would also be disposed of in this facility.

Waste concrete would be disposed of in a disposal facility with appropriate waste acceptance criteria. No concrete contaminated with hazardous or radioactive materials would be disposed of in this facility.

Some hazardous wastes would be generated by construction activities at the proposed SNS. In addition, radioactive scrap steel and concrete waste could be generated as a consequence of reusing slightly radioactive steel and/or concrete from other DOE sites in the construction of several permanent proposed SNS buildings. Any hazardous wastes generated during construction at the proposed SNS would be managed in accordance with applicable requirements under the Resource Conservation and Recovery Act (RCRA).

Portable toilets would be used as sanitary waste facilities during construction of the proposed SNS. The waste in these toilets would be removed on a regular schedule by a qualified sanitary waste contractor. In the latter phases of construction, some of the new buildings would be connected to the permanent sanitary waste system for the proposed SNS site. In such cases,



these facilities would be used instead of the portable toilets.

### 3.2.2.12 Noise

Construction activities at the proposed SNS site would generate noise produced by heavy construction equipment, trucks, power tools, and percussions from pile drivers, hammers, and dropped objects. In all cases, the levels of noise would be representative of levels at large-scale building sites. Table 3.2.2.12-1 describes peak and attenuated noise levels expected from operation and construction equipment.

Relatively high and continuous levels of noise would be produced by heavy equipment operations during the site preparation phase of construction. However, after this time, heavy equipment noise would become more sporadic and brief in duration.

The noise from trucks, power tools, and percussion would be sustained through most of the building erection and equipment installation activities on the proposed SNS site. As construction activities reach their conclusion, sound levels on the proposed SNS site would decrease to levels typical of daily SNS operations.

### 3.2.2.13 Air Emissions

Construction of the proposed SNS would result in some pollutant emissions to the atmosphere. However, these emissions would be temporary. The primary emission during construction would be fugitive dust during the clearing and grading of the site. Dust suppression techniques, primarily water sprays with a dust suppressant, would be used to control dust.

**Table 3.2.2.12-1. Peak and attenuated noise levels (in dBA) expected from operation of construction equipment.**

Source	Peak Noise Level	Distance from Source			
		50 ft	100 ft	200 ft	400 ft
Heavy trucks	95	84-89	78-83	72-77	66-71
Dump trucks	108	88	82	76	70
Concrete mixer	108	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80-89	74-82	68-77	60-71
Bulldozer	107	87-102	81-96	75-90	69-84
Generator	96	76	70	64	58
Crane	104	75-88	69-82	63-76	55-70
Loader	104	73-86	67-80	61-74	55-68
Grader	108	88-91	82-85	76-79	70-73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Forklift	100	95	89	83	77

Source: Golden et al. 1980.

### 3.2.3 OPERATIONS

Operation of the proposed SNS in the 1-MW configuration would begin in FY 2005, when most of the construction activities at the proposed SNS site would have been completed. These operations would continue for the 40-year design life of the facility. However, this design life would not preclude operational extensions beyond 40 years (DOE 1997c). This section identifies the workforce required for operations and characterizes the proposed SNS operations in terms of resource requirements and operational activities that have the potential to cause impacts, such as air emissions and waste discharges.

#### 3.2.3.1 Workforce

The proposed SNS would be operated by a permanently assigned staff and visiting scientists. Permanent staffing would begin with facility commissioning, currently scheduled for FY 2004-2005. By the first full year of operation, FY 2006, approximately 250 individuals would be working at the proposed SNS—approximately 180 resident employees (scientists and support personnel) and 70 visiting scientists. Approximately 125 additional people would be added to the workforce when the second target is completed.

It is anticipated that 1,000 to 2,000 visitors and sightseers would tour the proposed SNS each year. This level of visitation would begin during the first full year of operations and continue throughout the life of the facilities. The proposed SNS would have a visitor center as an integral part of the facility. In addition, portions of the facility would be designed to allow viewing by the visiting public.

#### 3.2.3.2 Traffic

The commuting by proposed SNS staff and visiting scientists would constitute the heaviest operations-related traffic in the vicinity of the proposed SNS. This traffic would begin at relatively low levels with commissioning of the proposed SNS site in FY 2004-2005. By the first full year of operations in 2006, a substantial increase in daily round trips to the proposed SNS site would occur. This level of commuter traffic would continue until the proposed SNS is supplied with an additional ring and target and operated at 4 MW. After this upgrade and an attendant increase to approximately 375 employees, the daily round trips would increase to approximately 302. The addition of a small number of visiting scientists after the upgrades would minimally increase daily round trips to the proposed SNS.

The traffic generated by delivery vehicles, service vehicles, and visitors (3/day) to the proposed SNS site would always be a much smaller component of the operations-related traffic than the commuter traffic. However, later upgrades to the proposed SNS may be associated with small increases in such traffic. For the remaining life of the proposed SNS, daily round trips would stabilize at approximately 305 per weekday (refer to Table 3.2.3.2-1).

#### 3.2.3.3 Material Consumption

Operational activities at the proposed SNS would consume a wide array of raw materials. Table 3.2.3.3-1 lists the major raw materials that would be used by proposed SNS operations. However, at this time the quantities of materials that would be consumed are not known.

**Table 3.2.3.2-1. Operations traffic.**

Activity	Daily Round Trips
Maximum employee commutes/day	302/day <sup>1</sup>
Service vehicles and supply trucks	3/day
<b>Total number of vehicles</b>	<b>305/day</b>

<sup>1</sup>Value taken from Table 5.2.10.1-2.  
Source: Tables 5.1.10.1-2, 5.2.10.1-1, 5.3.10.1-2, and 5.4.10.1-1

**Table 3.2.3.3-1. Proposed SNS raw material usage.**

Materials	Use
Charcoal absorbent	Absorber system in gaseous waste system. Removes mercury from off-gases
Refrigerant fluid	Air conditioning equipment in the linac tunnel
Helium gas	Gas distribution and cryogenic systems
Nitrogen gas	Gas distribution and cryogenic systems
Hydrogen gas	Gas distribution and cryogenic systems, moderators, and targets
Deuterium gas	Gas distribution and cryogenic systems
Argon gas	Gas distribution system and beam loss monitoring
Oxygen gas	Gas distribution system
Acetylene gas	Gas distribution system
Diesel fuel	Electrical system (emergency generators)
Gasoline	Yard and ground maintenance operations
Oil	Yard and ground maintenance operations and electrical system
Scintillation cocktail	Research laboratories
Laboratory chemicals (acids, bases, solvents, etc.)	Research laboratories

Source: ORNL 1997b

### 3.2.3.4 Utilities

Daily operations at the proposed SNS would be heavily dependent upon the utility systems that serve the site. This would be especially true for the accelerator systems and target systems that require large supplies of electrical power for operation and water for cooling.

Table 3.2.3.4-1 shows the utility systems that would serve the proposed SNS, their operational functions, and the projected quantities of utility-based energy and raw materials that would be used per unit time during operation of the proposed SNS. The listed quantities reflect projected peak use of energy and raw materials

per unit time for the facility at 1 MW and fully upgraded at 4 MW.

### 3.2.3.5 Air Emissions

Air emissions from the proposed SNS during operations would be primarily ventilation air from the linac tunnel, accumulator rings, and target building. The linac and ring tunnels would be ventilated to allow hands-on maintenance when the facility is not operating. The ventilation system would be designed to include a short retention time before the air is released to the environment. The type and amount of radionuclides that would be released during operations at both 1-MW and 4-MW

**Table 3.2.3.4-1. Proposed SNS utility systems.**

<b>Utility System</b>	<b>Operational Functions in Proposed SNS</b>	<b>Projected Use / Unit Time</b>
Natural gas	Feeds fuel to the boilers and localized unit heaters in the building heating system.	1,000 lb/hr - maximum
Water	Supplies water to the tower water cooling system, deionized cooling water system, chilled water system, building heating system, process water system, potable water system, demineralized water system, fire suppression system, and two target moderators.	800 gpm - 1 MW 1,600 gpm - 4 MW
Electrical	Supplies electrical power to the accelerator and target systems, instrumentation and control systems, communications and alarm systems, lighting systems, cathodic protection systems, and all other systems/equipment that use electricity.	62 MW power supply to deliver a 1-MW beam 90 MW power supply to deliver a 4-MW beam

Source: ORNL 1997b.

beam powers are shown in Table 3.2.3.5-1. Only radionuclides that make up one percent or more of the total number of curies released are included in the table.

There would be air emissions from the proposed SNS target system, primarily during periods of maintenance. Ventilation air from the target system would be compressed into tanks for a minimum of seven days to allow many of the short-lived radionuclides to decay. The air would then be released through charcoal and HEPA filters to the atmosphere. The type and amount of radionuclides that would be released from the target systems are included in Table 3.2.3.5-1.

Air pollutants would be emitted from the beam stops. The release of radionuclides from the beam stops would only occur during maintenance. No releases would occur during normal operations of the proposed SNS. Gases released from the beam stops would be compressed into tanks to allow radionuclides to decay for a minimum of seven days. The air would then be released through HEPA filters to the atmosphere. The type and amount of radionuclides that would be released from the

cooling systems, target systems, beam stops, and tunnel confinement are included in Table 3.2.3.5-1. All air releases would be through monitored stacks on the proposed SNS buildings.

### 3.2.3.6 Effluent Discharges

Operation of the cooling towers, groundwater interceptor system, and stormwater drainage system would result in effluent discharges to soil and/or surface water bodies at the proposed SNS. These discharges would consist of cooling tower blowdown, any groundwater that might collect in the groundwater interceptor system under the concentric shielding design, and stormwater runoff from the proposed SNS site.

During operation of the proposed SNS, excess heat must be removed from many of the components. Many components of the linac are water-cooled. The beam stops would be designed to dissipate the energy of the beam and thus would be water-cooled. Components of the target assembly would also be water-cooled. Some of this heat would be recovered and used for general space heating; however, most of this heat would be dissipated to the environment

**Table 3.2.3.5-1. Projected annual emissions of radionuclides from proposed SNS facilities.**

Nuclide <sup>c</sup>	Target Building Exhaust (Ci)						Tunnel Confinement Exhaust (Ci)		Total	
	Cooling Systems <sup>a</sup>		Target Off-Gas <sup>a</sup>		Beam Stops <sup>b</sup>		Linac, Ring, and Beam Transfer Tunnels <sup>b</sup>			
	1 MW	4 MW	1 MW	4 MW	1 MW	4 MW	1 MW	4 MW	1 MW	4 MW
H-3	2.8	11.1	22.4	89.6	0	0	0	0	25.2	100.7
C-10	0	0	0	0	0	0	25.5	40.4	25.5	40.4
C-11	0	0	0	0	0	0	40.6	60.4	40.6	60.4
N-13	0	0	0	0	0	0	318	483	318	483
O-14	0	0	0	0	0	0	89.9	133	89.9	133
O-15	0	0	0	0	0	0	341	519	341	519
Al-28	0	0	0	0	0	0	8.6	0	8.6	0
Ar-37	126	502	0	0	250	467	0	0	376	969
Xe-125	0	0	1.2	5	0	0	0	0	1.2	5
Xe-127	0	0	80.5	322	0	0	0	0	80.5	322
Hg-197	0	0	3.6	14.4	0	0	0	0	3.6	14.4
Hg-203	0	0	3.3	13.2	0	0	0	0	3.3	13.2
Total	128.8	513.1	111	444.2	250	467	823.6	1235.8	1313.4	2660.1

<sup>a</sup> DeVore 1998h.<sup>b</sup> DeVore 1998c.<sup>c</sup> Nuclides listed contribute one percent or more of the total activity released from a given system.

through a bank of eight mechanical cooling towers. Approximately 500 gpm (1,892 lpm) of water would be required for operation of the cooling towers; approximately half of this water would be released to the atmosphere, mostly in the form of water vapor. The other half of the water would be released as blowdown to surface water. In order to upgrade the proposed SNS to 4-MW beam power, five additional cooling towers would need to be installed and approximately 700 gpm (2,650 lpm) of water would be required for operation of the cooling towers.

The cooling tower blowdown water would not contain any radioactivity. The water would contain biocides and anti-scaling agents required for proper operation of the tower. Cooling towers dissipate heat primarily by evaporation. Therefore, the constituents in the water would be concentrated by a factor of four. The

temperature of the blowdown would be between 90 and 95 °F (32 and 35 °C).

The blowdown water would be dechlorinated, if necessary, and released to the approximate 2 acre (0.81 ha) retention basin. The retention basin would be designed with an appropriate residence time to allow the water to cool further, before being released to the environment. If necessary, the retention basin would include fountain or water sprays to assure that the temperature of the water released to the environment would be within 5°F of the temperature of the receiving stream.

The groundwater interceptor system beneath the beam shielding berms would collect any water that might penetrate the water-diverting barrier in the berms and infiltrate through the berm soil. Only a minimal amount of water would be expected in this system. This water would be

collected in a sump that would be inspected monthly, and any water found in the sump would be removed and sampled. If contamination were found, the water would be transported to the appropriate waste treatment systems. Water with no contamination would be released to the stormwater drainage system.

The stormwater drainage system on the proposed SNS site would intercept precipitation runoff from the proposed SNS buildings, walks, plazas, roads, parking lots, and landscape surfaces. The majority of this water would be directed to the retention basin. The retention basin would allow excess silt to settle out before the water would be released through the surface water discharge. This discharge would require a National Pollutant Discharge Elimination System (NPDES) permit.

### 3.2.3.7 Waste Generation

All wastes generated by the proposed SNS would be handled according to procedures already in place at the selected site for the SNS would result in the generation of four types of waste (Table 3.2.3.7-1).

Sanitary and hazardous wastes are considered solid waste under RCRA and state-administered waste management rules. Solid waste can occur in the form of solids, liquids, or gases. The types of solid waste generated by operations at the proposed SNS would include hazardous waste, primarily liquids such as solvents, and nonhazardous and nonradioactive waste generated by human sanitation activities at the proposed SNS. This waste would be generated in both solid and liquid form. It would include trash, human waste, and waste liquids such as personal shower wash and rinse water. In addition, the generated solid waste would

include mixed waste, which is waste that contains both hazardous and radioactive constituents.

Low-level radioactive waste would be generated by operations at the proposed SNS. This waste would be generated in liquid form [liquid low-level waste (LLLW)] and solid form (solid low-level waste) (ORNL 1997b: 8-139 to 8-140). Further details of waste generation and disposal can be found in Chapter 5.

### 3.2.3.8 Safety

Daily operations at the proposed SNS would entail a number of potential hazards to human safety and health. The proposed SNS would be designed, constructed, and operated to protect workers and the public from these potential hazards.

The potential hazards associated with operations at the proposed SNS would fall into two major categories: standard industrial hazards and nonstandard industrial hazards. Most of the hazards posed by the proposed SNS operations would be standard industrial hazards. These hazards would be posed by the presence of combustible materials (general materials, hydrogen gas, and natural gas); electrical energy (high voltage); potential energy (cranes); mechanical energy (forklifts and other vehicles); asphyxiants (refrigerant fluid and helium); and toxic, corrosive, or oxidizing materials. Additional potential hazards common to the proposed SNS and many other industrial facilities would include laser operations, electrical power outages, and general fires. The potential nonstandard industrial hazards would consist of ionizing radiation; nonionizing radiation; magnetic fields; and toxic, corrosive, or oxidizing materials (mercury target) not

**Table 3.2.3.7-1. Annual waste generation by the proposed SNS.**

<b>Waste Type</b>	<b>Generation Rate 1-MW Beam</b>	<b>Generation Rate 4-MW Beam</b>
Hazardous Waste		
Liquid	41 m <sup>3</sup> /yr	41 m <sup>3</sup> /yr
Low-Level Radioactive Waste		
Liquid	166 m <sup>3</sup> /yr	665 m <sup>3</sup> /yr
Process waste (potentially LLW)	3,940 m <sup>3</sup> /yr	15,800 m <sup>3</sup> /yr
Solid	513 m <sup>3</sup> /yr	1,026 m <sup>3</sup> /yr
Mixed Waste		
Liquid	10.8 m <sup>3</sup> /yr	10.8 m <sup>3</sup> /yr
Solid	3.5 m <sup>3</sup> /yr	7 m <sup>3</sup> /yr
Sanitary Waste		
Liquid	47 m <sup>3</sup> /yr	69 m <sup>3</sup> /yr
Solid	900 m <sup>3</sup> /yr	1,349 m <sup>3</sup> /yr

normally classified as standard industrial hazards (ORNL 1997b: 9-6 to 9-8). Engineering and administrative controls would be implemented to protect the proposed SNS workers and the public from these operational hazards.

Engineering controls would be incorporated during design and construction of the proposed SNS. The buildings, systems, and equipment that comprise the proposed SNS would be designed and constructed in accordance with the Uniform Building Code; National Electric Code; fire, life safety, and piping codes; and other applicable and appropriate consensus standards (ORNL 1997b: 9-5). The use of combustible materials in construction and equipment would be limited (ORNL 1997b: 9-19). Smoke and fire detection systems would conform to National Fire Protection Association standards relevant to their construction and installation, as would the fire suppression systems installed throughout the proposed SNS (ORNL 1997b: 9-20).

Workers would be protected from ionizing radiation during operations by established distances from sources and installed shielding.

The shielding design policy for the proposed SNS (ORNL 1997b: 9-12) limits the radiation dose rate to that specified in 10 CFR 835 (less than 100 mrem annually for a maximally exposed nonradiological worker). The shielding, consisting of steel, lead, concrete, and earth, would be supplemented by a variety of engineered systems and controls, including beam containment and monitoring systems, radiation detectors and monitors, audible/visible radiation warning devices, scram buttons in areas subject to irradiation, locked doors, and interlock systems to disable the beam if anyone attempts to enter the tunnels or target area during beam operations (ORNL 1997b: 9-12 to 9-16). The proposed SNS would be equipped with additional engineering features to prevent the uncontrolled release of radioactive mercury and other radioactive materials in the event of an operational accident (ORNL 1997b: 9-16 to 9-19).

The proposed SNS would be operated in strict compliance with a variety of administrative, safety, and health controls. These controls would include all applicable portions of the Occupational Safety and Health Administration

(OSHA) regulations; federal, state, and local environmental statutes and regulations; “Work Smart Standards” derived from DOE orders and guidance; and current safety and health procedures of the Management and Operations contractor organization. The continuation of safe operations would be bolstered by a regular program of safety evaluations and compliance audits.

The proposed SNS would be a low-hazard facility with no significant potential to affect off-site residents or nearby travelers. Emergency preparedness planning would emphasize operational contingencies that support impacted workers or equipment at the facility. An emergency plan would be developed to ensure that emergency response resources could be applied quickly and efficiently at the proposed SNS (ORNL 1997b: 9-22).

### 3.2.3.9 Noise

Operations at the proposed SNS would not produce continuous noise at high or extreme (>90 dB) levels. The same would be true for intermittent noises, although an unforeseeable incident might occur that would briefly spike a high noise level. The highest level of noise among proposed SNS operations would be produced by the cooling towers. Overall noise levels on the proposed SNS site, including operation of the cooling towers, would be comparable to existing noise levels at the host national laboratory. During the landscaping process, trees would be strategically planted to create noise barriers (ORNL 1997b: 8-27).

## 3.2.4 ALTERNATIVE SITES

Four alternative sites are considered in detail in this FEIS (refer to Appendix B). Through the screening process discussed below, four

alternative sites for construction and operation of the proposed SNS were identified: ORNL, LANL, ANL, and BNL. DOE used a phased approach to identify potential siting alternatives for the proposed SNS. The first phase narrowed the potential sites for placement of the proposed SNS to four of the DOE national laboratories. The second phase involved identifying a specific location within each of the four national laboratories. The approach to site selection is summarized below. Further details are provided in Appendix B.

### 3.2.4.1 Identification of Alternative Sites

This section describes the requirements and processes that were used to determine sites for the construction and operation of the proposed SNS.

#### 3.2.4.1.1 Technical/Logistical Requirements

The initial task in the site-selection process involved the definition of specific project requirements. These requirements were used to develop technical and logistical site exclusion criteria. For siting the proposed SNS, the following criteria were deemed necessary to meet the mission goal of supporting neutron science research and providing neutrons for materials research:

- A site with a minimum area of 110 acres (45 ha) and a rectilinear shape to accommodate the length of the proposed linear accelerator and possible future expansion of the facility.
- A 1-mi (1.6-km) buffer zone around the proposed SNS site to restrict uncontrolled public access and to insulate the public from the consequences of a postulated accident at the facility.



- Proximity and availability of an adequate electric power source. The regional power grid must be able to supply 40 MW of power during periods of operation. The site must be within 0.25 to 1 mile (0.4 to 1.6 km) of existing transmission lines to minimize collateral construction impacts and costs.
- Presence of existing neutron science programs and infrastructure to provide a pool of neutron science expertise and experience to meet mission goals. The site must have major facilities and programs utilizing neutron scattering techniques.

#### **3.2.4.1.2 Phase 1 Site Selection**

DOE conducted a site-selection process (Appendix B) to systematically identify suitable alternative sites for the proposed SNS. This process followed a two-tiered approach. The first level consisted of a decision to limit potential proposed SNS sites to existing DOE facilities. The second was identification of the basic technical and logistical requirements for meeting the mission goals of the proposed SNS Project (refer to Appendix B).

#### **3.2.4.1.3 Use of Existing DOE Facilities**

The logical universe of candidate sites for the proposed SNS in the United States was classified into three major categories: (1) existing DOE sites; (2) DOE acquisition and development of other federal property or a new, privately owned site; or (3) joint use of a nonfederal site (i.e., an academic facility).

DOE has an estimated 2.37 million acres (0.96 million ha) of land and many facilities nationwide from which to select candidate sites (DOE 1997b). Not suitable for the development of the proposed SNS are DOE operations offices, site offices, power administrations, and

special purpose offices. The search was limited to facilities, such as national laboratories, that would likely have sufficient land holdings to accommodate the proposed SNS.

Other existing federal sites included Department of Defense facilities (e.g., closed U.S. Air Force bases) or lands managed by other federal agencies, such as the Department of the Interior. DOE also had the option of acquiring a new, privately owned site through purchase, trade, or possible condemnation. However, acquisition of these properties would have required lengthy, costly, and detailed site selection, environmental compliance, and jurisdictional transfer processes. In addition, while some of these sites might have offered the physical, power, and infrastructure requirements needed to meet the proposed SNS Project mission goals, none of them could offer the necessary neutron science and infrastructure support requirements.

A final candidate site category included co-location of the proposed SNS facility at a nonfederal location, such as an academic center or private research facility. This category was dropped from further consideration because few, if any, non-DOE facilities could offer neutron science and infrastructure support needed for efficient operation of the SNS. Also, establishing a facility with the overall magnitude of the proposed SNS would be similar to establishing another national laboratory. This site category would not maximize the use of existing federal and/or DOE resources, would not be cost efficient, and could duplicate existing DOE missions, thereby being in direct conflict with current DOE initiatives, as defined in several recently released studies and reports (DOE 1997b).

Therefore, it was deemed appropriate to limit the search for alternative proposed SNS sites to federal properties. Furthermore, this search was limited to specific types of DOE facilities, such as the national laboratories, because of their scientific and technical infrastructures.

Most of the DOE-owned or -operated facilities were immediately eliminated from consideration because of the nature of the sites or the uniqueness of the programs carried out at the sites. For example, DOE operations offices were excluded from the list of considered sites because they are typically in office buildings located in or near downtown population areas, and they lack sufficient land to meet proposed SNS Project objectives. DOE power administration offices and most special project offices are specialized, and they do not have the necessary program experience or infrastructure to support the proposed SNS. Examples would include the oil reserves in California and Louisiana and the oil shale reserves in Colorado and Wyoming. Based on the 4 DOE facility-screening criteria, 39 DOE facilities or sites were carried forward as the universe of potential sites for the proposed SNS.

Each of the 39 facilities was reviewed against the 4 major exclusion criteria. Failure of a site to meet any of the four criteria resulted in its elimination from further consideration. Through this process, 35 facilities were eliminated. The four remaining sites represent the array of reasonable site alternatives for the proposed SNS. These sites are ORNL, LANL, ANL, and BNL. They are the siting alternatives considered for detailed analysis in this FEIS (refer to Sections 3.2.4.2. through 3.2.4.5).

#### **3.2.4.1.4 Phase 2 Site Selection**

Phase 2 of the site-selection process involved selecting a specific location for the proposed SNS at each of the four national laboratories. DOE sent the proposed SNS site requirements to each of the four national laboratories, each of which was responsible for selection of their preferred site for the proposed SNS. The four site alternatives identified by the site-selection process are described briefly below. Detailed characterization of each site is presented in Chapter 4.

#### **3.2.4.2 Oak Ridge National Laboratory (Preferred Alternative)**

As required by CEQ regulations for implementing NEPA [40 CFR 1502.14(e)], DOE has identified the preferred alternative: to construct and operate the proposed SNS at ORNL in Oak Ridge, Tennessee. This alternative would allow DOE to take advantage of the highly trained staff at ORNL and the experience gained during development of the conceptual design for the Advanced Neutron Source.

The Oak Ridge Reservation (ORR) is located in and around the city of Oak Ridge, Tennessee. It was acquired by the federal government in 1942 for the wartime Manhattan Project. The ORR contains three major facilities: ORNL, the Y-12 Plant, and the East Tennessee Technology Park (ETTP, formerly the K-25 Site), and occupies approximately 35,516 acres (14,379 ha) in Roane and Anderson counties. The ORR and the proposed site for the SNS are shown in Figure 3.2.4.2-1. This site was selected through a formal evaluation process. The site-selection report describing this process is provided in Appendix B.

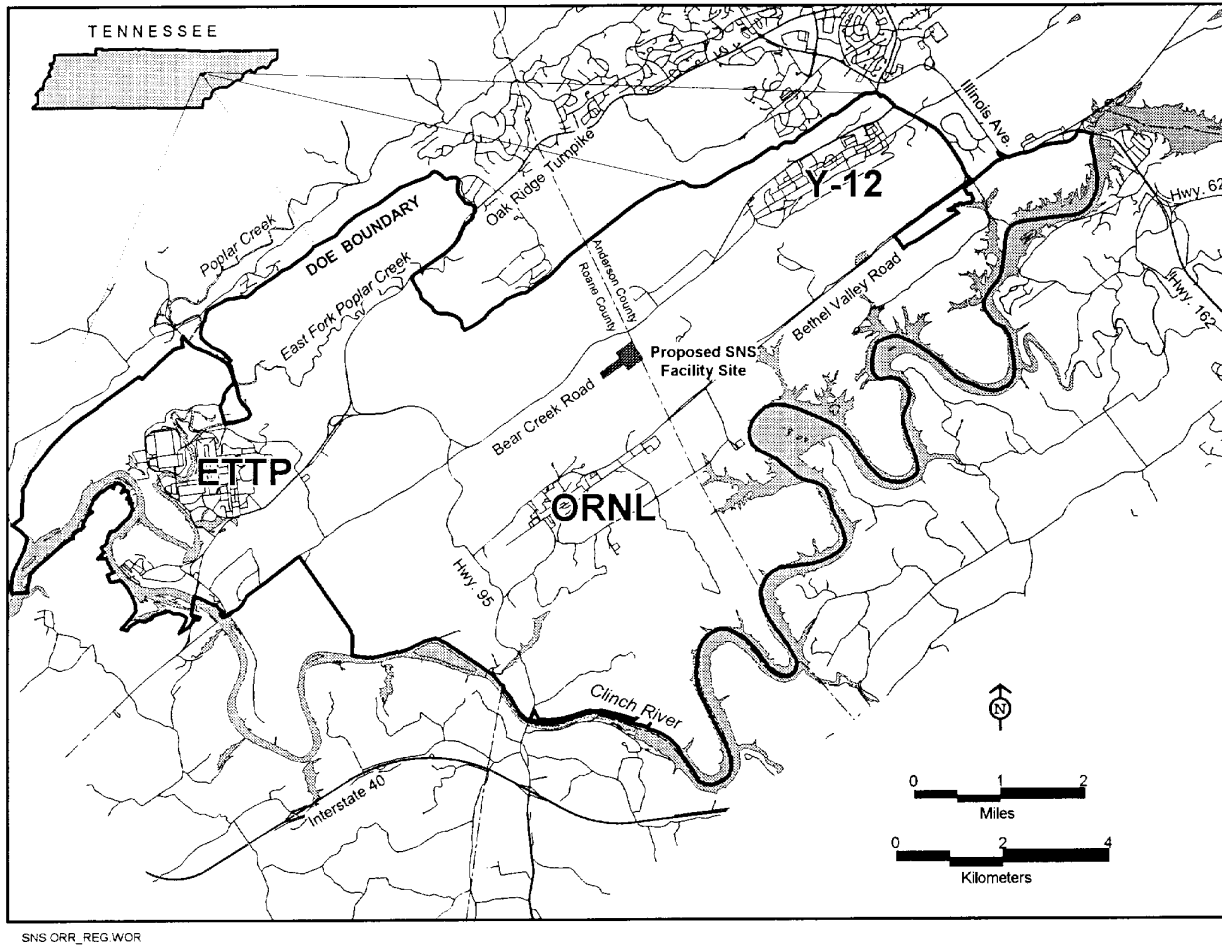


Figure 3.2.4.2-1. ORNL proposed SNS site.

In response to a request received during the public review of the DEIS, DOE also investigated the potential of a brownfield site, the White Wing Scrap Yard, for siting the SNS. The White Wing Scrap Yard is a major brownfield site located on the ORR near the intersection of State Highways 58 and 95. It consists of approximately 30 acres of land known to be radioactively contaminated. This contamination extends to areas of land immediately adjacent to this area on all sides and extends along two unnamed tributaries of Bear Creek that flow out of this area to the south and southeast. This site would not be an environmentally desirable location for the proposed SNS because of its location relative to environmentally sensitive areas and the presence

of a potentially unstable geological feature (refer to Appendix A, comment P-1-1).

The proposed site along Chestnut Ridge comprises a long, wide, and gently sloping ridge top with a broad saddle area at its eastern end. This area is planned for the target station and would require a minimum of excavation. The linac, transport line, and ring tunnels would be notched into the south side of the ridge using cut-and-fill techniques, providing economical construction and effective shielding strategies. Initial characterization of the site indicates bedrock located approximately 150 feet below the planned level of the accelerator components with very stable soil being the primary matrix for emplacement of the physical plant.

Appropriate foundations would provide the required stability for the accelerator and support structures. The entire site is currently undeveloped.

Table 3.2.4.2-1 describes site-specific information concerning utilities and infrastructure requirements at the ORNL site. Detailed characterization of the ORNL site is provided in Section 4.1.

### 3.2.4.3 Los Alamos National Laboratory

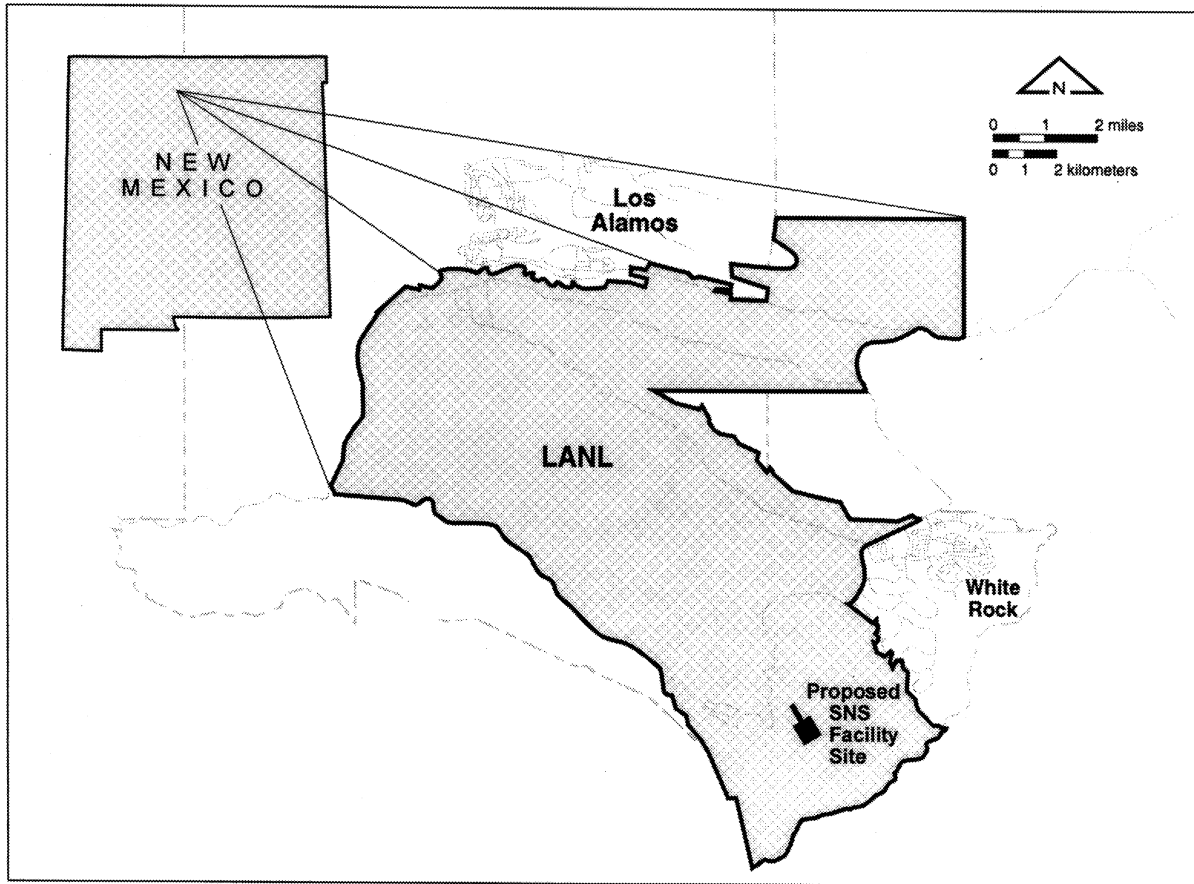
This alternative would involve the construction and operation of the proposed SNS on a site at

LANL. The geographic location of LANL is illustrated in Figure 3.2.4.3-1. The site was selected through a formal evaluation process. Appendix B contains the site-selection report describing this process.

LANL is located in Los Alamos County in north-central New Mexico, approximately 60 miles (97 km) north-northwest of Albuquerque and 25 miles (40 km) northwest of Santa Fe. The 43-mi<sup>2</sup> (111-km<sup>2</sup>) laboratory is situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep east-to-west oriented canyons cut by intermittent streams.

**Table 3.2.4.2-1. Utility and infrastructure requirements for the proposed SNS site at ORNL.**

Facility Requirements	Site-Specific Attributes
Site access	Primary access is by Chestnut Ridge Road from Bethel Valley Road. The condition of Chestnut Ridge Road is passable and of gravel construction. The road is currently accessible through a gate with virtually no traffic on this road. Approximately 2 miles (3.2 km) of Chestnut Ridge Road would be upgraded in accordance with the Tennessee Department of Transportation (DOT) standards and specifications to support heaviest anticipated traffic, including emergency vehicles weighing up to 20 tons.
Borrow material and spoils disposal	The proposed SNS will have soil berms shielding the linac, storage rings, and beam transfer lines. The source of the material for the berms is stockpiled material from the site excavation. New service road would be constructed from the proposed SNS site to the West Borrow Area, located approximately 1,500 ft southwest of the proposed site. The West Borrow Area is an operating source of dirt and fill material for projects on the ORR.
Electrical power	Power required for the proposed SNS (62 MW for 1-MW beam; 90 MW for 4-MW beam) would be provided by the DOE-owned 161-kV transmission line located less than 3,000 ft (914 m) west of the site. A feed line would be constructed from the existing line to a new primary substation at the proposed SNS site.
Potable water	Potable water [800 gpm (3,028 lpm) for 1-MW beam; 1,600 gpm (6,057 lpm) for 4-MW beam] would come from 24-in (61-cm) ORNL water main, which runs through the eastern end of the proposed site. Existing capacity within the plant and supply lines is available to meet anticipated demand.
Natural gas	Natural gas (1,000 lb/hr in winter months) would be piped from the ORNL 100-psig distribution header from the East Tennessee Natural Gas Company (ETNG) B-Station. Approximately 5,000 ft (1,524 m) of pipeline would be constructed along Chestnut Ridge Road to the site. The ETNG line is sized sufficiently to supply the demand at the proposed SNS.
Steam	The proposed SNS facility would include steam generation. Steam is available from the ORNL steam plant but would require a minimum of 1.5 miles (2.4 km) of insulated steam pipe, a condensate collection system, and/or a return system.
Compressed air	The proposed SNS facility would include air compressors.
Chilled water	The proposed SNS facility would include water chillers (32,000 tons).



**Figure 3.2.4.3-1. LANL proposed SNS site.**

Since its inception in 1943 as the Manhattan Project's site for development of the first nuclear weapons, LANL's primary mission has been nuclear weapons research and development and related projects.

Most laboratory and community development is confined to the mesa tops. The surrounding land is largely undeveloped, and large tracts of land north, west, and south of the laboratory are held by the Santa Fe National Forest, Bureau of Land Management, Bandelier National Monument, General Services Administration, and Los Alamos County. The Pueblo of San Ildefonso borders the laboratory to the east. Table 3.2.4.3-1 describes site-specific information concerning utilities and infrastructure requirements at the LANL site. Detailed

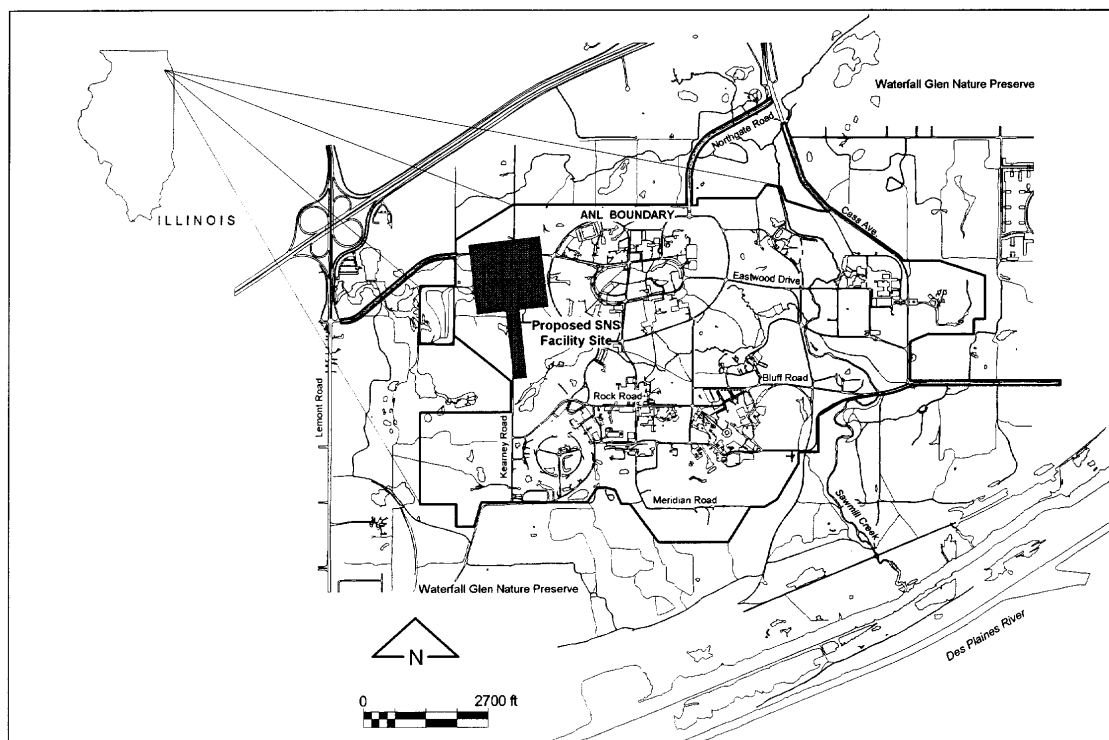
characterization of the proposed project site is provided in Section 4.2.

#### **3.2.4.4 Argonne National Laboratory**

The implementation of this alternative would involve constructing and operating the proposed SNS on a site at ANL. Like ORNL, ANL was established in 1942 as a part of the Manhattan Project. ANL's mission is research and development in basic energy and related sciences and is an important engineering center for the study of nuclear and nonnuclear energy sources. Figure 3.2.4.4-1 shows the geographic location of ANL. This site was selected through a formal evaluation process. The site-selection report outlining this process is provided in Appendix B.

**Table 3.2.4.3-1. Utility and infrastructure requirements for the proposed SNS site at LANL.**

Facility Requirements	Site-Specific Attributes
Site access	Primary access would be via a new access road off State Road 4 to the proposed SNS site. State Road 4 is a rural state highway, and any highway upgrades would have to be negotiated with the New Mexico State Highway Department. Other traffic concerns may be associated with access to Bandelier National Monument.
Borrow material and spoils disposal	Borrow material sources within LANL are limited and are not located near the proposed SNS site. One option would be to negotiate with Los Alamos County for borrow material currently located at the Los Alamos County Landfill.
Electrical power	LANL's existing electrical power system infrastructure is not adequate to support an additional 62-MW (1-MW beam) or 90-MW (4-MW beam) demand. It would be necessary to bring in a new 115 kV line from east of the site or to construct an SNS site-specific power generator. The specific siting of a new line is still under evaluation.
Potable water	Accommodating this need [800 gpm (3,028 lpm) for 1-MW beam; 1,600 gpm (6,057 lpm) for 4-MW beam] would require extensive potable water delivery system upgrades, including many lines, lift stations, and storage tanks. The nearest potable water system at Technical Area (TA)-39 would not be able to provide the required demand.
Natural gas	Natural gas is not available. Alternate energy source (e.g., electricity) would be necessary for space heating and hot water.
Steam	The proposed SNS facility would include steam generation.
Compressed air	The proposed SNS facility would include air compressors.
Chilled water	The proposed SNS facility would include water chillers.



SNS F-1 WCR 9APR99 8a

**Figure 3.2.4.4-1. ANL proposed SNS site.**

ANL occupies 1,500 acres (610 ha) of gently rolling land in the Des Plaines River Valley of DuPage County, Illinois. It is about 27 miles (43 km) southwest of downtown Chicago and 24 miles (39 km) west of Lake Michigan. Surrounding the ANL site is the Waterfall Glen Nature Preserve, a 2,040-acre (826-ha) greenbelt forest preserve of the DuPage County Forest Preserve District. This land was deeded to the DuPage County Forest Preserve District in 1973 for use as a public recreation area, nature preserve, and demonstration forest. Nearby highways are Interstate 55 to the north and Illinois Highway 83 to the east. The Des Plaines River is located about 0.4 mi (0.6 km) south of ANL. The Chicago Sanitary and Ship Canal is about 0.6 mi (1.0 km) south of the laboratory. The section of the Illinois and Michigan Canal that lies within the Illinois and Michigan Canal National Heritage Corridor is located about 0.8 mi (1.3 km) south of ANL. The Calumet-Sag Channel is located about the same distance to the southeast of the laboratory boundary.

Table 3.2.4.4-1 describes site-specific information concerning utilities and infrastructure requirements at the ANL site. Detailed characterization of the proposed ANL site is provided in Section 4.3.

#### **3.2.4.5 Brookhaven National Laboratory**

This alternative would involve the construction and operation of the proposed SNS on a site at BNL. The geographic location of BNL on Long Island is illustrated in Figure 3.2.4.5-1. A formal evaluation process was used to select this site. The site-selection report describing this process is provided in Appendix B.

The BNL is located in Suffolk County on Long Island, approximately 60 miles (97 km) east of New York City. The BNL is situated on 5,263 acres (2,130 ha) of land, most of which is wooded and undeveloped. The BNL was established in 1947 as a part of the Manhattan Project. It was established on the former site of Camp Upton, a U.S. Army facility during World Wars I and II. The BNL's current mission is to conceive, design, construct, and operate large, complex research facilities for fundamental scientific studies and to conduct basic and applied research in the physical, biomedical, and environmental sciences and in selected energy technologies. Table 3.2.4.5-1 provides site-specific information concerning utilities and infrastructure requirements at the BNL site. Detailed characterization of BNL is provided in Section 4.4.

### **3.3 NO-ACTION ALTERNATIVE**

This alternative serves as a basis for comparison against other alternatives evaluated in the FEIS. It describes continuation of the current (status quo) situation into the future, if the proposed action is not implemented.

The No-Action Alternative for this FEIS would be to continue using the existing neutron science facilities in the United States without construction and operation of the proposed SNS at the preferred site or one of the three alternative sites. Because of currently high and ever-increasing demand for access to neutron science facilities, the existing U.S. facilities would increasingly fail to meet domestic experimentation demand under the No-Action Alternative.

**Table 3.2.4.4-1. Utility and infrastructure requirements for the proposed SNS site at ANL.**

Facility Requirements	Site-Specific Attributes
Site access	Primary access is from <u>Westgate and Northgate Roads</u> . <u>Westgate Road</u> is a two-lane blacktop road that currently handles mostly automobile traffic and handles intermittent heavy truck traffic. <u>Westgate Road</u> is capable of handling construction traffic. Approximately 1 mile (1.6 km) of <u>Westgate Road</u> would have to be constructed, circumventing the proposed SNS site, to replace the access to ANL from the West Gate.
Borrow material and spoils disposal	Borrow material could be obtained by providing retention ponds and replacement wetland areas. Any additional material would be obtained from clean fill sources outside of ANL.
Electrical power; Connected	Electrical power of 62 MW for a 1-MW beam and 90 MW for a 4-MW beam are required for the proposed SNS. Remaining capacity of 50 MW exists from substation 549A. This substation would have to be upgraded to provide the necessary power. A 6,600-ft (2,012-m) long 138-kV overhead line is needed to connect the proposed SNS site to substation 549A. The route for the 138-kV line is from substation 549A, up Southwood Drive and along Outer Circle Road to Watertower Road to the 800 Area.
Potable water	Potable water is supplied to ANL from Lake Michigan. The current system can meet the proposed SNS demand [800 gpm (3,028 lpm) for 1-MW beam; 1,600 gpm (6,057 lpm) for 4-MW beam].
Non-potable water	Non-potable water, suitable for cooling tower operation, is available from the ANL Canal Water Distribution System [remaining capacity is about 2 mgpd (7.6 million lpd)]. Approximately 2,000 ft (610 m) of pipeline would be constructed along <u>Westgate Road</u> .
Natural gas	The ANL gas distribution system delivers 10 psig. Approximately 2,000 ft (610 m) of gas line would be constructed from the existing distribution system along <u>Westgate Road</u> to the proposed site. The natural gas lines around the ANL site are scheduled to be upgraded next year. Any capacity increases and/or line extensions could be incorporated in this upgrade.
Steam	Steam heat would require about 1,500 ft (457 m) of steam lines. ANL can accommodate about 300,000 lb/hr of additional steam demand.
Compressed air	The proposed SNS facility would include air compressors.
Chilled water	The proposed SNS facility would include water chillers.

### 3.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

There are several different methods for producing high-power, short-pulse beams of protons in the 1-GeV power range that were evaluated during the conceptual design of the proposed SNS. The following alternatives were considered; however, DOE concluded that they are technically inferior. Additional details of the technical rationale can be found in the

*Conceptual Design Report* (ORNL 1997a and 1997b).

#### 3.4.1 PARTIAL-ENERGY LINAC AND A RAPID-CYCLING SYNCHROTRON

The partial-energy linac and a rapid-cycling synchrotron is a well-understood, proven accelerator technology. However, significant drawbacks to this approach make it unsuitable for the proposed SNS. The most important concern is associated with future upgrades to a higher operating power and thus increased research capability. Unlike the full-energy linac



of the proposed SNS, which allows upgrading the facility to 2-MW beam power without a major construction project, any and all updates to a synchrotron facility would require major construction activity. Even modest upgrading (2-MW) of the facility would be a major construction project, entailing the building of a

second booster synchrotron to reach the proton energy necessary for the higher beam power. A fully upgraded facility (4 MW) would require a beam energy on target of 10 GeV. This upgrade would require changing the design of the target, moderators, and shielding, thereby undertaking another large-scale construction project.

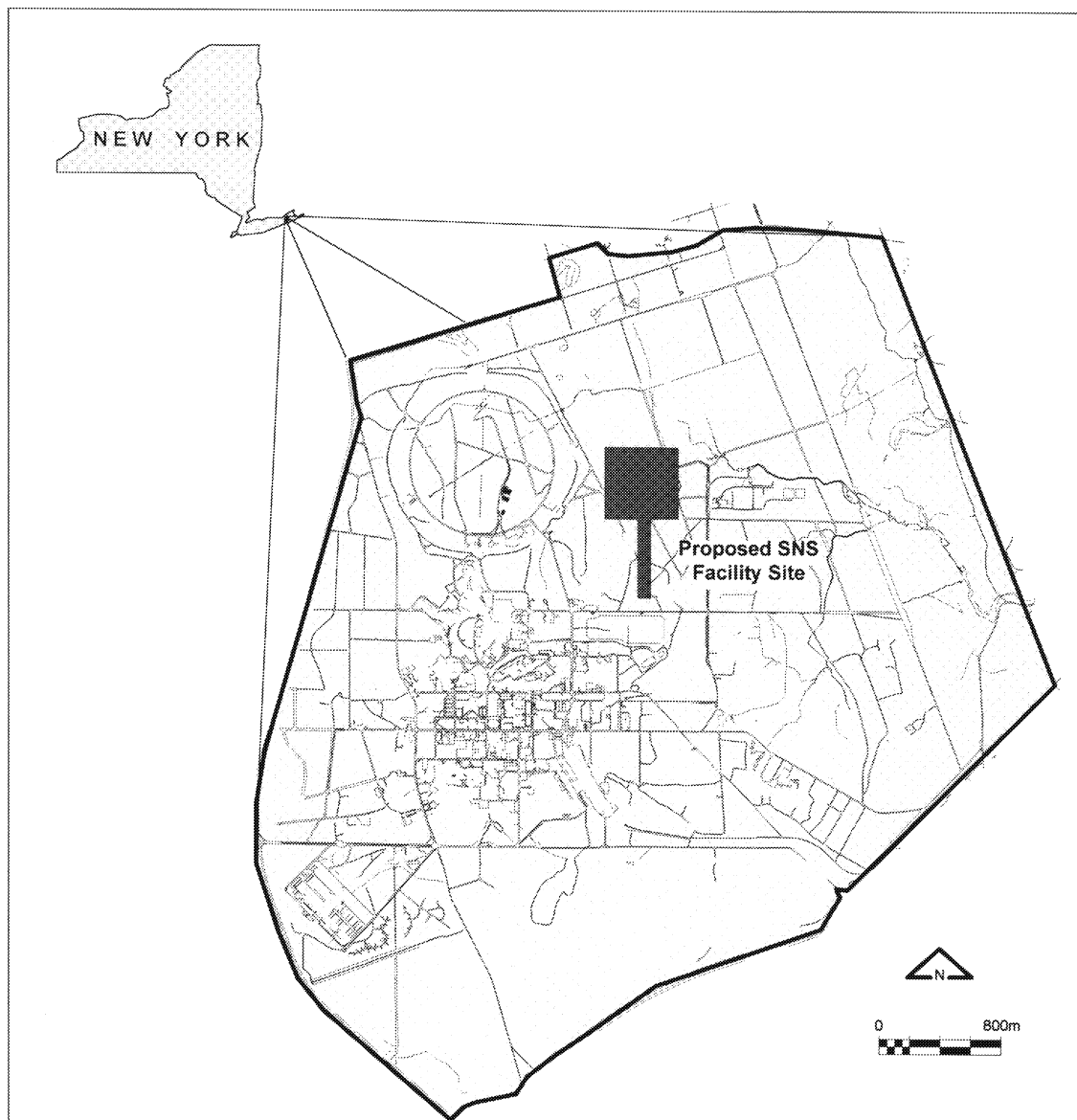


Figure 3.2.4.5-1. BNL proposed SNS site.

**Table 3.2.4.5-1. Utility and Infrastructure requirements for the proposed SNS site at BNL.**

<b>Facility Requirements</b>	<b>Site-Specific Attributes</b>
Site access	Primary access is from East Fifth Avenue and Relativistic Heavy Ion Collider Road. Existing roads are adequate for anticipated traffic.
Borrow material and spoils disposal	Material for the soil berm would come from various firebreaks on BNL. Spoils would be stored in the BNL transfer station.
Electrical power	For the demands of 62-MW (1-MW beam) or 90-MW (4-MW beam) a new 69-kV transmission line would have to be constructed to the LILCO 138-kV grid. The length of the line would be approximately 1 mile (1.6 km), and it would run parallel to BNL's existing stand-by 69-kV transmission line. The LILCO grid would require a new 138-to-69-kV substation.
Potable water	Potable water demands [800 gpm (3,028 lpm) for a 1-MW beam; 1,600 gpm (6,057 lpm) for 4-MW beam] could be supplied by three domestic water wells in the area, each capable of producing approximately 1,200 gpm (4,542 lpm).
Natural gas	The present usage peaks at approximately 200,000 ft <sup>3</sup> /hr, and 40,000 ft <sup>3</sup> /hr is available. The gas line is approximately 4,000 ft (1,219 m) from the proposed site.
Steam	The present steam load at BNL peaks at 170,000 lb/hr. The present steam plant has a firm capacity of 295,000 lb/hr. There is sufficient capacity for an estimated load of 1,500 lb/hr, which is required for the Long Island climate.
Compressed air	The proposed SNS facility would include air compressors.
Chilled water	The proposed SNS facility would include water chillers.

The second most important concern with the partial-energy linac and rapid-cycling synchrotron option is the limited flexibility for accommodating different pulse frequencies. The proposed SNS would be designed to produce neutron pulses at varying rates of 10 to 60 Hz. The normal operating mode of the synchrotron would be 30 Hz. Higher repetition rates are not possible and lower rates can only be achieved by discarding some of the 30-Hz pulses, which would result in a loss of overall power delivered to the target.

This alternative would not allow DOE to meet the purpose and need for action. Therefore, it is not analyzed further in this FEIS.

### **3.4.2 FULL-ENERGY SUPERCONDUCTING LINAC WITH AN ACCUMULATOR RING**

This alternative incorporates superconductivity technology into the design of the proposed SNS. Superconductivity technology is quite mature for

fabricating magnets and constructing several radio-frequency linacs. The Continuous Electron Beam Accelerator Facility, located in Newport News, Virginia, and the Large Electron-Positron located in Switzerland are examples of superconducting cavities that have met stringent accelerator requirements for technical performance and reliability. Both of these structures are designed for electron beams, and they operate in continuous wave mode.

However, the requirements for the proposed SNS include pulsed operations. Anticipated problems with pulsed operation using superconducting linacs have been identified and characterized, but they have not been resolved (Alonso 1998). Although there is an ongoing research and development program in Europe, it is unknown whether good technological solutions can be found within the necessary time frame. This could result in an indefinite delay in providing the required neutron source that fulfills the purpose and need (refer to Chapter 2).

The research and development of superconducting pulsed linacs will be closely watched to possibly incorporate breakthroughs that may come. However, the proposed SNS Project has insufficient resources to conduct the extensive research and development program that would be required to resolve the technical uncertainties associated with this technology. Therefore, this alternative is not analyzed further in this FEIS.

### **3.4.3 INDUCTION LINAC, EITHER FULL-ENERGY OR INJECTING A FIXED-FREQUENCY ALTERNATING GRADIENT ACCELERATOR**

The induction linac offers the attractive possibility of producing very short pulses of very high current without the need for an accumulator or synchrotron ring. However, no existing induction linac has accelerated protons to the energies required by the next-generation neutron source. Designing such an accelerator is viewed as straightforward and, in fact, an initial feasibility study has been performed. However, costs would be greater than for options utilizing rings, and the reliability of the high-power switches for the required service life is viewed as problematic. Although a concerted development effort for this technology is currently underway at LBNL, too much technical uncertainty remains to accept this technology as viable for the proposed SNS.

The fixed-frequency alternating gradient accelerator component of the induction linac presents some attractive features, most notably the ability to efficiently accelerate high-current beams injected by either an rf linac or, most intriguingly, by an induction linac. Studies on the viability of a fixed-frequency alternating gradient accelerator design have been conducted for spallation source application in both Europe and the United States. However, as is the case

with the induction linac, no fixed-frequency alternating gradient accelerator has been built in the range of performance required for the proposed SNS, and the technology is not viewed as mature enough to be technically viable at this time. Therefore, this alternative is not analyzed further in this FEIS.

## **3.5 ENVIRONMENTAL CONSEQUENCES**

This section provides a comparative summary of the potential environmental impacts that would result from implementing the proposed action at each of the four SNS siting alternatives and from implementing the No-Action Alternative. All impacts are described in terms of the various aspects of the existing environment that might be expected to change over time as a result of their implementation. This summary is based on the detailed environmental impacts identified and described in Chapter 5 of this FEIS.

Table 3.5-1 covers the environmental impacts, which are presented according to internal headings that correspond to the major impacts analysis subheadings in Chapter 5 of this FEIS. Under the other internal headings, this table covers impacts on long-term productivity of the environment and cumulative impacts. Cumulative impacts are the effects on the existing environment that would result from the incremental effects of the proposed action when added to the effects from other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal), private industry, or individuals undertake these other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

This page intentionally left blank.

**INDEX****Table 3.5-1 Comparison of impacts among alternatives.**

<b>Category</b>	<b>Page</b>
1a. Impacts on Geology and Soils (Construction) .....	3-47
1b. Impacts on Geology and Soils (Operations) .....	3-47
2a. Impacts on Water Resources (Construction) .....	3-47
2b. Impacts on Water Resources (Operations) .....	3-48
3a. Impacts on Climate and Nonradiological Air Quality (Construction).....	3-49
3b. Impacts on Climate and Nonradiological Air Quality (Operations) .....	3-49
4a. Impacts on Noise Levels (Construction) .....	3-49
4b. Impacts on Noise Levels (Operations) .....	3-50
5a. Impacts on Ecological Resources (Construction) .....	3-50
5b. Impacts on Ecological Resources (Operations) .....	3-52
6a. Impacts on Socioeconomics (Construction) .....	3-54
6b. Impacts on Socioeconomics (Operations) .....	3-55
7a. Impacts on Cultural Resources (Construction) .....	3-56
7b. Impacts on Cultural Resources (Operations) .....	3-58
8a. Impacts on Land Use (Construction).....	3-59
8b. Impacts on Land Use (Operations) .....	3-61
9a. Impacts on Human Health (Construction).....	3-64
9b. Impacts on Human Health (Operations).....	3-65
9c. Impacts on Human Health (Accidents) .....	3-66
10a. Impacts on Support Facilities and Infrastructure (Construction) .....	3-66
10b. Impacts on Support Facilities and Infrastructure (Operations) .....	3-67
11a. Impacts on Waste Management (Construction and Operations).....	3-70
12a. Impacts on Long-Term Productivity of the Environment (Operations) .....	3-76
13a. Cumulative Impacts (Construction and Operations) .....	3-76

This page intentionally left blank.

Table 3.5-1. Comparison of impacts among alternatives.

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
1a. Impacts on Geology and Soils (Construction)				
No effects from seismicity.				No effects from seismicity.
Erosion and siltation during construction. Minimal effects on soils or site stability.				No effects on soils or site stability.
<u>No effects on prime or unique farmlands because none are present on or near any of the proposed SNS sites.</u>				<u>No effects on prime or unique farmlands.</u>
1b. Impacts on Geology and Soils (Operations)				
The soil in the berm used to shield the linac tunnel would be subject to neutron activation caused by a small portion of particles (hydrogen ions) escaping from the particle beam as it travels down the linac. An estimated total of 3.09 E05 Ci of radioactive isotopes would be generated in the soil berm by neutron activation over the life of the facility. The maximum design beam loss rate is 1.0 E-09 amps per meter of linac. This design limit is the same for all linac beam power levels, hence soil activation would be the same at both 1 and 4 MW. For the analysis of potential effects, the beam loss is assumed to be 10.0 E-09. The total curies (3.09 E05) is based on this conservative limit.				No effects on soils.
No effects from seismicity or on site stability because of design to meet known seismic hazards at ORNL, LANL, ANL, or BNL.				No effects from seismicity.
<u>No effects on prime or unique farmlands because none are present on or near any of the proposed SNS sites.</u>				<u>No effects on prime or unique farmlands.</u>
2a. Impacts on Water Resources (Construction)				
No effects on floodplains. Minimal increase in run-off and siltation from improvements to Chestnut Ridge Road.	No effects on floodplains.	Construction in small areas on the 100-year floodplains of two unnamed tributaries of Sawmill Creek and Freund Brook. The areas of floodplain that would be affected are, respectively, 5 acres (2 ha) and <1 acre (0.40 ha).	No effects on floodplains.	No effects on floodplains.
Minimal effects on surface water (see Impact 1a).				No effects on surface water.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
2b. Impacts on Water Resources (Operations)				
No effects on floodplains.				No effects on floodplains.
Overall effects expected to be minimal. Discharges to surface water would increase average base flow, resulting in increased stream velocity and channel erosion in White Oak Creek. Minimal effects from biocides and antiscaling agents relative to flow. Slight increase in radionuclide flux over White Oak Dam.	Overall effects expected to be minimal. Discharges to surface water would result in channel erosion in intermittent TA-70 drainages. Most flow would infiltrate soil before reaching Rio Grande River. Minimal effects from biocides and antiscaling agents relative to flow.	Overall effects expected to be minimal. Discharges to surface water would increase base flow, resulting in increased stream velocity and channel erosion in an unnamed tributary of Sawmill Creek. Minimal effects from biocides and antiscaling agents relative to flow.	Overall effects expected to be minimal. Discharges to surface water would increase base flow, resulting in increased stream velocity and channel erosion in the headwaters of the Peconic River. Most flow would infiltrate the subsurface in the river channel before reaching the BNL boundary. Minimal effects from biocides and antiscaling agents relative to flow.	No effects on surface water resources.
Potential localized increase in groundwater radionuclide concentrations (at a depth of 100 ft or more) due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. Three radionuclides would equal or exceed the 10 CFR Part 20 limit (shown in parentheses) at 10 m away from the site: <sup>14</sup> C 4.4 E-04 μCi/cc (3E-04 μCi/cc), <sup>22</sup> Na 5.5 E-05 μCi/cc (6 E-06 μCi/cc), and <sup>54</sup> Mn 3.0 E-05 μCi/cc (3 E-05 μCi/cc).	Pumping may lower water levels in nearby wells and affect productivity of main aquifer. Potential localized increase in groundwater radionuclide concentrations due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. Groundwater effects would be least likely at LANL because of low infiltration rate and greater depth [820 ft (250 m)] to main aquifer.	Potential localized increase in groundwater radionuclide concentrations due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. A potable groundwater aquifer lies at a depth of 165 ft (50 m). The downward rate of water movement through the saturated zone of the Wadsworth Till is only 3.0 ft/yr (0.9 m/yr). High clay content of the till would retard radionuclide migration, (continued on next page)	Highest potential for increase in groundwater radionuclide concentrations due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. The sole source aquifer for Long Island would lie only 20 ft (6.1 m) below the SNS. High permeability of the soils [17 ft/yr (5.2 m/yr)] would allow higher levels of radionuclides in the aquifer in the immediate vicinity of the SNS. Exceedance of (continued on next page)	No effects on groundwater resources.



Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
2b. Impacts on Water Resources (Operations) — continued				
		but accurate prediction of migration rates and potential for aquifer contamination would be difficult because of the complex deposits.	drinking water limits for a human receptor at an off-site location would be unlikely.	
3a. Impacts on Climate and Nonradiological Air Quality (Construction)				
Temporary increases in suspended particulates (PM <sub>10</sub> ) during work hours (10-hr day). Primarily fugitive dust from vegetation clearing, excavation, and land contouring.				No effects on nonradiological air quality.
3b. Impacts on Climate and Nonradiological Air Quality (Operations)				
No effects on local or regional climate.				No effects on local or regional climate.
Combustion of natural gas would emit air pollutants, CO <sub>2</sub> , CO, NO <sub>2</sub> , and PM <sub>10</sub> , limited by NAAQS. Off-site levels of pollutants would all be less than 20% of the NAAQS limit. Diesel back-up generators would only run in an emergency. Effects on nonradiological air quality would be expected to be minimal.	Combustion of natural gas would emit air pollutants, CO <sub>2</sub> , CO, NO <sub>2</sub> , and PM <sub>10</sub> , limited by NAAQS. Off-site levels of pollutants would all be less than 5% of the NAAQS limit. Diesel back-up generators would run only in an emergency. Effects on nonradiological air quality would be expected to be minimal.			No effects on nonradiological air quality.
4a. Impacts on Noise Levels (Construction)				
Short-term increase in noise to continuous moderate levels (approximate average level of 86 dBA). Effects on humans and wildlife would be minimal because of distances (more than 400 ft) from sources, natural barriers, and worker hearing protection.				No effects on noise levels.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
4b. Impacts on Noise Levels (Operations)				
Elevated continuous noise levels from cooling towers, compressors, and ventilation fans/blowers (approximate average level of 86 dBA). Minimized with landscape barriers. Periodically increased traffic noise. Minimal overall noise effects to human and wildlife populations.				No effects on noise levels.
5a. Impacts on Ecological Resources (Construction)				
Removal of vegetation from 110 acres (45 ha) of land (less than 0.5% of the total forested area of the ORR) would result in increased forest fragmentation. This would have a minimal effect on terrestrial wildlife movement because a forested path along Chestnut Ridge would be retained. Only a portion of the ridge and ORR would be affected.	Removal of vegetation from 110 acres (45 ha) of land. Minimal effects on wildlife movement or the roosting, feeding, and reproduction of birds because 90% of TA-70 would remain undeveloped.	Removal of vegetation from 110 acres (45 ha) of land partially developed in the past. This would result in a long-term reduction of wildlife habitat and populations on the SNS site and in adjacent areas. These effects would be minimal because the species that would be involved are neither rare nor game species and other habitat exists in the region.	Removal of vegetation from 110 acres (45 ha) of land would displace wildlife to surrounding areas. The displacement of this wildlife may exceed the wildlife carrying capacity of the adjacent areas, resulting in a small but permanent population reduction for one or more species. The proposed site lies within the Compatible Growth Area of the Pine Barrens. The 110 acres represent less than 20% of the Pine Barrens Protection Area.	No effects on terrestrial resources.
Construction would temporarily disturb wildlife occupying areas adjacent to the proposed site. This could result in emigration of some sensitive species from the surrounding area.				No effects on terrestrial resources.
Construction of the SNS facility would not directly impact wetlands. The Chestnut Ridge Road upgrade would eliminate 0.23 acres (0.09 ha) of wetland, which includes parts of three wetlands. Clearing and (continued on next page)	No effects on wetlands within the SNS site or in TA-70 because there are no wetlands on or in the vicinity of the proposed site.	Approximately 3.5 acres (1.4 ha) of wetlands would be destroyed by construction. DOE would consult with regulatory agencies on plans to mitigate their loss. Temporary, minor effects on other wetlands surrounding (continued on next page)	There are no wetlands within the proposed SNS site. Minimal effects on Peconic River wetlands from runoff and sedimentation because of implementing runoff and erosion control measures.	No effects on wetlands.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
5a. Impacts on Ecological Resources (Construction) — continued				
<u>grading for a proposed detention pond has the potential to indirectly affect a nearby wetland. Indirect impacts may include increased runoff and siltation and long-term impacts such as altered hydrology and changes in the vegetation community. There would be minimal effects on four additional wetlands located outside of the construction area. Appropriate mitigation measures, including implementation of proper construction techniques to control erosion and surface runoff and wetland replacement or enhancement would be employed to minimize effects on these wetlands.</u>		the proposed site may occur during construction. These indirect impacts would be avoided or minimized through the implementation of proper construction techniques to control erosion and surface runoff.		
Minimal effects on aquatic resources from increased runoff and sediment loading in White Oak Creek due to runoff and erosion control measures. Minimal effects on cool water fish (banded (continued on next page)	No effects on aquatic resources. There are no aquatic resources on or in the vicinity of the proposed site.	Minimal effects on aquatic resources, particularly bottom-dwelling fauna, from increased runoff and sediment loading in Freund Brook, because of establishing a 100- to 200-ft (continued on next page)	Minimal effects on aquatic resources from increased runoff and sediment loading in the Peconic River, because of establishing a minimum 300-ft (91-m) uncleared vegetation buffer zone (continued on next page)	No effects on aquatic resources.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
5a. Impacts on Ecological Resources (Construction) — continued				
sculpin and blacknose dace) habitat from vegetation clearing and associated solar radiation increase of water temperature in White Oak Creek, because of leaving a 100- to 200-ft (30- to 60-m) uncleared vegetation buffer zone along the creek for shade.		(30- to 60-m) uncleared vegetation buffer zone along the brook and implementing erosion control measures.	between the SNS site and the river and implementing erosion control measures.	
Potential effects on threatened and endangered (T&E) plant species would be minimal due to implementation of protective measures. No T&E or other protected animal species were identified within the proposed footprint of the SNS.	Potential effects on American peregrine falcon and bald eagle population from small reductions in non-nesting habitat would be minimal. No T&E plant species were identified on the SNS site.	No protected species were identified on the proposed SNS site. Therefore, no effects on T&E or other protected species.	Potential effects on state-protected plant species identified on the SNS site due to implementation of protective measures would be minimal. No T&E or other protected animal species were identified on the SNS site.	No effects on T&E or other protected species.
5b. Impacts on Ecological Resources (Operations)				
<u>During operations, cooling water and runoff from the site would be directed to the retention basin and discharged into White Oak Creek downstream of Bethel Valley Road; thus, increased runoff and sedimentation in wetlands in the vicinity of the site is not expected to occur. Road runoff would be</u> (continued on next page)	Minimal effects on wetlands in arroyos of Ancho Canyon and unnamed canyon to the northeast because cooling water flow could not reach these areas, except possibly during a heavy rain event.	During operations, runoff from the site would be directed to the retention basin; thus, increased runoff to wetlands in the vicinity of the site would be expected to be minimal.	No effects on wetlands.	

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
5b. Impacts on Ecological Resources (Operations) - (continued)				
<u>diverted to stormwater control structures, such as swales, to avoid the effects of increased runoff in wetlands.</u>				
Minimal effects on aquatic resources in the headwaters area of White Oak Creek. Cooling water and runoff from the proposed site would be collected in the retention basin. Discharge to White Oak Creek would be south of Bethel Valley Road. If necessary, the cooling tower blowdown would be dechlorinated. The retention basin would allow for reduction in the temperature of the water prior to discharge in White Oak Creek. Only minimal effects to aquatic resources downstream from the discharge point would be expected.	No effects on aquatic resources.	Biotic communities in Sawmill Creek may change as a result of increased flow from cooling water and runoff discharged into it from the retention basin. These effects on aquatic resources would be minimal because the temperature of the discharge would be reduced to ambient temperature in the retention basin.	No effects on aquatic resources in the upper reaches of the Peconic River because cooling water and runoff in the retention basin would be released to the river near the current Sewage Treatment Plant outfall. Downstream flow increase would be less than a routine rain event, resulting in minimal effects to aquatic resources. If necessary, the cooling tower blowdown would be dechlorinated. The retention basin could allow for reduction in the temperature of the water prior to discharge to the Peconic River. Only minimal effects to aquatic resources would be expected.	No effects on aquatic resources.
May affect T&E plant species. Protective measures would be implemented. No T&E or other protected animal species were (continued on next page)	No T&E plant species were identified on the proposed SNS site. May affect the American peregrine falcon and bald eagle populations (continued on next page)	No known T&E or other protected species at ANL would be affected.	May affect state-protected plant species. Protective measures would be implemented. No T&E or other protected animal (continued on next page)	No effects on T&E or other protected species.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
5b. Impacts on Ecological Resources (Operations) — continued				
identified on the proposed SNS site. Two plants protected by the State of Tennessee, pink lady’s slipper and American ginseng, were found in areas adjacent to the proposed site.	because their use of the SNS site area would be less likely after development.		species were identified on the proposed SNS site.	
6a. Impacts on Socioeconomics (Construction)				
Peak construction workforce of 578 workers would occur during construction of the 1-MW facility. Approximately 25% of workers may come from outside the Region of Influence (ROI). Based on experience with past major construction projects, most in-migrating workers would not relocate their families. However, if all in-migrating workers brought families into the area, the regional population would increase by approximately 0.01–0.02%. This would have minor effects on housing and regional community services.				No effects on regional population growth.
Design and construction employment would peak in FY 2002 during construction of the 1-MW facility. Based on modeling of regional economics, there would be an estimated 1,499 new jobs created, including direct, indirect, and induced jobs.  Unemployment rate may potentially decrease from 3.2 to 3.0%.	Design and construction employment would peak in FY 2002 during construction of the 1-MW facility. Based on modeling of regional economics, there would be an estimated 1,447 new jobs created, including direct, indirect, and induced jobs.  Unemployment rate may potentially decrease from 6.6 to 5.8%.	Design and construction employment would peak in FY 2002 during construction of the 1-MW facility. Based on modeling of regional economics, there would be an estimated 1,795 new jobs created, including direct, indirect, and induced jobs  Because of the very large regional population, no decrease in the regional unemployment rate would be expected.	Design and construction employment would peak in FY 2002 during construction of the 1-MW facility. Based on modeling of regional economics, there would be an estimated 1,481 new jobs created, including direct, indirect, and induced jobs.  Unemployment rate may potentially decrease from 3.4 to 3.3%.	No economic benefit.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
6b. Impacts on Socioeconomics (Operations)				
Workforce for operation of the proposed SNS would be 250 persons for the 1-MW facility and 375 for the 4-MW facility. Regional population growth of approximately 0.01–0.03% due to worker in-migration would have minor effects on housing and regional community services.				No effects on regional socioeconomics.
Operation of the proposed SNS at 4 MW would result in substantial regional spending for operator salaries, supplies, utilities, and administrative support. Operation of the proposed SNS would result in a maximum of 1,704 direct, indirect, and induced jobs. Operations would result in approximately \$68.7 million in local wages, \$7.5 million in business taxes, and \$75.9 million in personal income.	Operation of the proposed SNS at 4 MW would result in substantial regional spending for operator salaries, supplies, utilities, and administrative support. Operation of the proposed SNS would result in a maximum of 1,486 direct, indirect, and induced jobs. Operations would result in approximately \$66.8 million in local wages, \$7.6 million in business taxes, and \$71.4 million in personal income.	Operation of the proposed SNS at 4 MW would result in substantial regional spending for operator salaries, supplies, utilities, and administrative support. Operation of the proposed SNS would result in a maximum of 1,776 direct, indirect, and induced jobs. Operations would result in approximately \$82.9 million in local wages, \$8.7 million in business taxes, and \$91.2 million in personal income.	Operation of the proposed SNS at 4 MW would result in substantial regional spending for operator salaries, supplies, utilities, and administrative support. Operation of the proposed SNS would result in a maximum of 1,551 direct, indirect, and induced jobs. Operations would result in approximately \$71.6 million in local wages, \$10.3 million in business taxes, and \$80.5 million in personal income.	No economic benefits.
Unemployment rate may potentially decrease from 3.2 to 3.0%.	Unemployment rate may potentially decrease from 6.6 to 5.8%.	Unemployment rate may potentially decrease from 5.2 to 5.1%.	Unemployment rate may potentially decrease from 3.4 to 3.2%.	
The effects of operation of the proposed SNS at the 1-MW power level would be similar but slightly less than the 4-MW case.				

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
6b. Impacts on Socioeconomics (Operations) — continued				
Operation of the proposed SNS would not cause high and/or adverse impacts to any of the surrounding populations. Therefore, there would not be a disproportionate risk of significantly high and adverse impact to minority and low-income populations.				The No-Action alternative would not cause high and/or adverse impacts to any of the surrounding populations. Therefore, there would not be a disproportionate risk of significantly high and adverse impact to minority and low-income populations.
7a. Impacts on Cultural Resources (Construction)				
No effects on prehistoric resources. No prehistoric cultural resources have been identified on or in the vicinity of the proposed SNS site.	Five prehistoric archaeological sites within the 65% survey area at the SNS site and eligible for listing on the NRHP would be destroyed by site preparation activities. In the unsurveyed area of the proposed SNS site, any prehistoric sites listed on or eligible for listing on the NRHP could also be destroyed by site preparation. If this site were chosen for construction of the SNS, the remaining 35% would be surveyed and assessed for specific effects prior to the initiation of construction activities. Effects on	Prehistoric site 11DU207, adjacent to the proposed SNS site, may be disturbed or destroyed by construction activities. ANL has not assessed the NRHP eligibility of site 11DU207. If this site were chosen for construction of the SNS, an assessment of eligibility would be performed prior to the initiation of construction activities. If it is determined that a cultural resource would be affected, the effects would be mitigated by avoidance, if possible, or data recovery.	No effects on prehistoric resources. No prehistoric No effects on prehistoric resources. No prehistoric cultural resources have been identified on or in the vicinity of the proposed SNS site.	No effects on prehistoric resources.



Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
	(continued on next page)			
7a. Impacts on Cultural Resources (Construction) — continued				
	prehistoric archaeological sites would be mitigated by data recovery.			
No effects on historic resources. No historic cultural resources have been identified on or in the vicinity of the proposed SNS site.	No effects on historic resources within the surveyed 65% of the SNS site and buffer zone because no such resources have been identified in these areas. Site preparation activities in the unsurveyed area of the proposed SNS site would destroy any historic sites, structures, or features listed on or eligible for listing on the NRHP. If this site were chosen for construction of the SNS, the 35% area would be surveyed and assessed for specific effects prior to the initiation of construction activities. Effects would be mitigated by data recovery.	<u>No effects on historic resources. No historic cultural resources have been identified on or in the vicinity of the proposed SNS site.</u>	A number of earthen features (potentially NRHP-eligible) at Stations 2, 4, 8, and 10 on the SNS site may have been associated with World War I trench warfare training at Camp Upton. They would be destroyed by construction activities. Effects would be mitigated by data recovery.	No effects on historic resources.
No effects on traditional cultural properties (TCPs). No TCPs identified on or in the vicinity of the proposed SNS site.	Five TCPs (prehistoric archaeological sites) within 65% survey area at SNS site would be destroyed by site preparation activities. If any prehistoric archaeological sites are located within the unsurveyed 35% of the SNS (continued on next page)	No effects on TCPs. No TCPs identified on or in the vicinity of the proposed SNS site.		No effects on TCPs.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
7a. Impacts on Cultural Resources (Construction) — continued				
	site, these TCPs would also be destroyed. Because specific identities and locations of other on-site TCPs are not known, potential effects on such specific resources are uncertain.			
7b. Impacts on Cultural Resources (Operations)				
No effects on prehistoric or historic resources. Operational activities would be largely confined to the SNS site. No prehistoric or historic cultural resources have been identified on or in the vicinity of the proposed SNS site.	No effects on prehistoric or historic resources. Operational activities would be largely confined to the SNS site. No prehistoric archaeological sites would be present on the site after construction. No historic cultural resources have been identified on the proposed SNS site.	No effects on prehistoric or historic resources. Operational activities would be largely confined to the SNS site. No prehistoric or historic cultural resources have been identified on the proposed SNS site.	No effects on prehistoric or historic resources. Operational activities would be largely confined to the SNS site. No prehistoric cultural resources have been identified on or in the vicinity of the proposed SNS site. No historic cultural resources would be present on the site after construction.	No effects on prehistoric or historic resources.
No effects on TCPs. No TCPs identified on or in the vicinity of the proposed SNS site.	American Indian tribal groups have identified water resources (surface water and groundwater) as TCPs. See Impacts 2b and 10b for operational effects on these TCPs. Because specific identities and locations of on-site TCPs are not known, potential operational effects on such specific resources are uncertain.	No effects on TCPs. No TCPs identified on or in the vicinity of the proposed SNS site.	No effects on TCPs. No TCPs identified on or in the vicinity of the proposed SNS site.	No effects on TCPs.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
8a. Impacts on Land Use (Construction)				
Introduce large-scale development to the proposed SNS site, utility corridors, and new rights-of-way. Considering that about 64% of the 34,516 acres (13,794 ha) of ORR land is undeveloped, this would be a minimal overall effect. A greenfield site is proposed because no brownfield sites that meet SNS requirements are available.	Introduce large-scale development to the proposed SNS site, utility corridors, and new rights-of-way. Considering the 16,000 acres (6,478 ha) of undeveloped land at LANL, the effect on undeveloped laboratory lands as a whole would be minimal.	Displace the remaining support services operations in the 800 Area. Demolition of the three remaining 800 Area buildings. These would be minimal effects. Introduce large-scale development to Open Space areas due to limited ANL land. Increase the pace of remediation on numerous Solid Waste Management Units (SWMUs) within the proposed SNS site. A beneficial effect would be use of a partial brownfield site for constructing the SNS.	Introduce large-scale development to the proposed SNS site, utility corridors, and new rights-of-way. Considering the large amounts of Open Space land at BNL, the effects would be minimal.	No effects on current land use.
The National Oceanic and Atmospheric Administration/ Atmospheric Turbulence and Diffusion Division (NOAA/ATDD) is conducting the Temperate Deciduous Forest Continuous Monitoring Program (TDFCMP) in the Walker Branch Watershed [0.75 mi. (1.2 km)] east of the proposed SNS site. This long-term program is monitoring the continuous exchange of CO <sub>2</sub> , (continued on next page)	No effects on the use of land by environmental research projects. Land on and in the vicinity of the SNS site is not being used for environmental research projects, and none are planned.	No effects on the use of land by environmental research projects. Land on and in the vicinity of the SNS site is not being used for environmental research projects, and none are planned. The ecology plots at ANL are areas of land potentially suitable for ecological research, but little, if any, actual ecological research has ever been conducted in these areas. Currently, there are no on- (continued on next page)	No effects on the use of land by environmental research projects. Land on and in the vicinity of the SNS site is not being used for environmental research projects, and none are planned.	No effects on the use of land by environmental research projects.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
8a. Impacts on Land Use (Construction) — continued				
H <sub>2</sub> O vapor, and energy between the deciduous forest and atmosphere. CO <sub>2</sub> from construction vehicles could affect the TDFCMP and one long-term ORNL ecological research project in the Walker Branch Watershed. Potential effects would be loss of CO <sub>2</sub> data quality and data comparability over time.		going or planned ecological projects in Ecology Plots 6, 7, and 8 on the proposed SNS site.		
Potential limitations on future use of the proposed SNS site and land areas adjacent to it.				No effects on future land use.
Reduce the area of ORR land open to recreational deer hunting by 110 acres (45 ha). Effect would be minimal because about 26,406 acres (10,735 ha) would still be open to hunting.	Potential restriction or end of public hiking trail use near the SNS site in TA-70.	No reasonably discernible effects on parks, preserves, and recreational resources. The effects from the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses outside ANL and within the laboratory boundaries.	No reasonably discernible effects on parks, preserves, and recreational resources. The effects from the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses in the vicinity of BNL.	No effects on parks, preserves, or recreational resources.
The proposed SNS would come into view only along the upper reaches of the Chestnut Ridge Road and southwest road accesses to the proposed SNS site. This (continued on next page)	Change views in SNS site area from piñon-juniper woodlands to industrial development. SNS facilities visible to public from points on State Route 4, access road (continued on next page)	<u>The proposed SNS facilities would be visible from points near the ANL fence in the Waterfall Glen Nature Preserve, especially on the west side during late autumn,</u> (continued on next page)	Most visual panoramas in the area around BNL and within the laboratory contain features indicative of development. The proposed action would add the SNS (continued on next page)	No effects on visual resources.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
8a. Impacts on Land Use (Construction) — continued				
effect would be minimal because these roads would be traveled primarily by DOE and ORNL personnel, construction workers, and service providers. It would not be visible to the public from land-based vantage points outside the ORR, most points on the ORR, or frequently traveled roads such as Bear Creek Road and Bethel Valley Road. No established visual resources on the ORR would include the proposed SNS.	to proposed SNS site, the site, and hiking trails in TA-70. Highly visible at night—absence of other lighted facilities. Not visible from White Rock and popular public use areas in Bandelier National Monument.	<u>winter, and early spring. They would also be visible from points within the laboratory boundaries. Because the current views at these locations contain buildings and other features characteristic of development, these effects would be minimal.</u>	facilities to this visual environment, and they would be compatible with it. This effect on visual resources would be minimal.	
8b. Impacts on Land Use (Operations)				
Land use change from Mixed Research/Future Initiatives to Institutional/Research.	Change in current land use from Environmental Research/Buffer to Experimental Science.	Change in current land use from Ecology Plots (Nos. 6, 7, and 8), Support Services, and Open Space to a programmatic land use category specific to SNS operations or Programmatic Mission-Other Areas.	Change in current land use from Open Space to Commercial/Industrial.	No effects on current land use.
CO <sub>2</sub> from SNS stacks would adversely affect TDFCMP (NO <sub>x</sub> minimal) and one ORNL research project in the Walker Branch Watershed. (continued on next page)	No effects on the use of land by environmental research projects. Land on and in the vicinity of the proposed SNS site is not being used for environmental research projects, and none are planned.			No effects on the use of land by environmental research projects.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
8b. Impacts on Land Use (Operations) — continued				
H <sub>2</sub> O vapor from cooling towers may affect the TDFCMP and two ORNL research projects. Effects would be loss of data quality and data comparability over time.				
No effects on DOE zoning (SNS operations compatible). Through a DOE process called Common Ground and a citizen stakeholder group referred to as the End Use Working Group, citizens in the Oak Ridge area have developed future ORR land use recommendations for DOE. Use of the proposed SNS site for the proposed action would be at variance with recommended Common Ground zoning of the site for Conservation Area Uses. It would also be at variance with an End Use Working Group recommendation advisory to use brownfield sites for new DOE facilities. A greenfield site is proposed for the SNS because no brownfield sites that meet project requirements are available.	No effects on DOE zoning (SNS operations compatible).	The SNS operations would be at variance with Support Services, Ecology Plot No. 8, and Open Space zoning on the SNS site. However, a guiding principle behind ANL zoning is the expansion of other land uses into the Ecology Plots and Open Space. The amount of Support Services land used would be negligible.	The SNS operations would be at variance with Open Space zoning on the SNS site. However, a guiding principle behind BNL zoning is expansion of other land uses into Open Space. Operation of the SNS would probably result in an eventual change in end use zoning of the SNS site and adjacent land from predominantly Open Space to Commercial/Industrial.	No effects on zoning for future land use.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
8b. Impacts on Land Use (Operations) — continued				
Future adverse CO <sub>2</sub> effects on the TDFCMP and two ORNL research projects. Minimal No <sub>x</sub> effects from SNS stacks. Potential future H <sub>2</sub> O vapor effects on the TDFCMP and eight ORNL research projects. Potential future effects on strategic ORNL ecological research initiatives. Effects would be loss of data quality and data comparability over time.	No future uses of SNS site and vicinity land for environmental research are planned. As a result, effects on specific future research projects cannot be assessed.	No future uses of SNS site and vicinity land for environmental research are planned. The ecology plots at ANL are areas of land potentially suitable for ecological research, but little, if any, actual ecological research has ever been conducted in these areas. There are no planned environmental research projects in the portions of Ecology Plots 6, 7, and 8 adjacent to the proposed SNS site. As a result, effects on specific future research projects cannot be assessed.	No future uses of SNS site and vicinity land for environmental research are planned. As a result, effects on specific future research projects cannot be assessed.	No effects on the future use of land by environmental research projects.
Potential limitations on future use of the proposed SNS site and land areas adjacent to it.				No effects involving future land use limitations.
Continued restriction of recreational deer hunting on 110-acre (45-ha) SNS site. Effect would be minimal because about 26,406 acres (10,735 ha) would still be open to hunting.	Continued restriction or end of public hiking trail use near the SNS site in TA-70.	No reasonably discernible effects on parks, preserves, and recreational resources. The effects from the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses outside ANL and within the laboratory boundaries.	No reasonably discernible effects on parks, preserves, and recreational resources. The effects from the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses in the vicinity of BNL.	No effects on parks, preserves, or recreational resources.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
8b. Impacts on Land Use (Operations) — continued				
The proposed SNS would come into view only along the upper reaches of the Chestnut Ridge Road and southwest road accesses to the proposed SNS site. This effect would be minimal because these roads would be traveled primarily by DOE personnel, SNS employees, service providers, and visitors to the SNS facilities, including visiting scientists. It would not be visible to the public from land-based vantage points outside the ORR, most points on the ORR, and frequently traveled roads such as Bear Creek Road and Bethel Valley Road. No established visual resources on the ORR would include the proposed SNS.	Change views in proposed SNS site area from piñon-juniper woodlands to industrial development. SNS facilities visible to public from points on State Route 4, access road to proposed SNS site, the site, and hiking trails in TA-70. Highly visible at night—absence of other lighted facilities. Not visible from White Rock and popular public use areas in Bandelier National Monument.	<u>The proposed SNS facilities would be visible from points near the ANL fence in the Waterfall Glen Nature Preserve, especially on the west side during late autumn, winter, and early spring. They would also be visible from points within the laboratory boundaries. Because the current views at these locations contain buildings and other features characteristic of development, these effects would be minimal.</u>	Most visual panoramas in the area around BNL and within the laboratory contain features indicative of development. The proposed action would add the SNS facilities to this visual environment, and they would be compatible with it. This effect on visual resources would be minimal.	No effects on visual resources.
9a. Impacts on Human Health (Construction)				
Based on rates for general industrial construction accidents, 110 potential occupational injuries but less than 1 fatality are predicted.				No effects on human health.
		Due to the preferred location of the SNS within the 800 Area SWMU, construction activities may expose workers to organic compounds and possibly radioactive materials.		



Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
9b. Impacts on Human Health (Operations)				
Considering population density and proximity, minimal effects on the health of workers or the public. For operation at 1-MW power, the maximally exposed individual (MEI) would receive an annual radiation dose of 0.40 mrem, or 4% of the 10-mrem limit (40 CFR Part 61). For operation at 4-MW power, the MEI would receive an annual dose of 1.5 mrem, or 15% of the limit.  Operation of the SNS at 1-MW power for 10 years and at 4-MW power for 30 years would result in 0.2 latent cancer fatalities (LCFs) in the off-site population attributable to the SNS.	Considering population density and proximity, minimal effects on the health of workers or the public. For operation at 1-MW power, the MEI would receive an annual radiation dose of 0.47 mrem, or 4.7% of the 10-mrem limit (40 CFR Part 61). For operation at 4-MW power, the MEI would receive an annual dose of 1.8 mrem, or 18% of the limit.  Operation of the SNS at 1-MW power for 10 years and at 4-MW power for 30 years would result in 0.09 LCFs in the off-site population attributable to the SNS.	Considering population density and proximity, minimal effects on the health of workers or the public. For operation at 1-MW power, the MEI would receive an annual radiation dose of 3.2 mrem, or 32% of the 10-mrem limit (40 CFR Part 61). For operation at 4-MWpower, the MEI would receive an annual dose of 12 mrem, or 120% of the limit.  Operation of the SNS at 1-MW power for 10 years and at 4-MW power for 30 years would result in 1.3 LCFs in the off-site population attributable to the SNS.	Considering population density and proximity, minimal effects on the health of workers or the public. For operation at 1-MW power, the MEI would receive an annual radiation dose of 0.91 mrem, or 9.1% of the 10-mrem limit (40 CFR Part 61). For operation at 4-MWpower, the MEI would receive an annual dose of 3.4 mrem, or <u>34%</u> of the limit.  Operation of the SNS at 1-MW power for 10 years and at 4-MW power for 30 years would result in 1.2 LCFs in the off-site population attributable to the SNS.	No effects on human health.
Potential effects on off-site population for combined operations at 1- and 4-MW power. Potential effects on off-site population predicted to maximally exposed individual for initial 1-MW (continued on next page)	Potential effects on off-site population for combined operations at 1- and 4-MW power. Potential effects on off-site population predicted to maximally exposed individual for initial 1-MW (continued on next page)	Anticipated effects on off-site population for combined operations at 1- and 4-MW power. Potential effects on off-site population predicted to maximally exposed individual for initial 1-MW (continued on next page)	Anticipated effects on off-site population for combined operations at 1- and 4-MW power. Potential effects on off-site population predicted to maximally exposed individual for initial 1-MW (continued on next page)	

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
9b. Impacts on Human Health (Operations) — continued				
and upgraded 4-MW operations — 0.2 excess LCFs over 40 years.	and upgraded 4-MW operations — 0.09 excess LCFs over 40 years.	and upgraded 4-MW operations — 1.3 excess LCFs over 40 years.	and upgraded 4-MW operations — 1.2 excess LCFs over 40 years.	No effects on human health.
No observable effects on workers or public from mercury emissions. Mercury levels would be approximately 100,000 times less than OSHA and NIOSH recommendations and the EPA reference concentration for members of the public.				No effects on human health.
9c. Impacts on Human Health (Accidents)				
Extremely unlikely that workers would be exposed to levels of direct radiation that could induce radiation effects. The SNS shield design would be such that with a high-consequence, low-probability design-basis accident, the dose to a maximally exposed individual would be 1 rem in an uncontrolled area and 25 rem for a worker in a controlled area.				No impacts on health.
No effects expected at 1 MW. At 4 MW, only “beyond-design-basis” accident estimated to occur less than once per 1,000,000 years would induce 31 excess LCFs in off-site population.	No effects expected.	No effects expected at 1 MW. At 4 MW, LCFs expected in off-site population for three accident scenarios: one “beyond-design-basis” accident (120 LCFs) occurring less than once per 1,000,000 years; one extremely unlikely accident (2.7 LCFs) occurring between once per 10,000 and once per 1,000,000 years; and one anticipated accident (2.1 LCFs).	No effects expected at 1 MW. At 4 MW, LCFs expected in off-site population for three accident scenarios: one “beyond-design-basis” accident (85 LCFs) occurring less than once per 1,000,000 years; one extremely unlikely accident (1.9 LCFs) occurring between once per 10,000 and once per 1,000,000 years; and one anticipated accident (1.6 LCFs).	No effects on human health.
10a. Impacts on Support Facilities and Infrastructure (Construction)				
Traffic on ORNL access roads would increase approximately 7%. The estimated peak construction workforce of 578 employees (continued on next page)	Traffic on LANL access roads would increase approximately 7%. The estimated peak construction workforce of 578 employees (continued on next page)	Approximately 1 mile (1.6 km) of the existing Westgate Road would have to be relocated to the north in order to circumvent the SNS (continued on next page)	Traffic on BNL access roads would increase approximately 16%. The estimated peak construction workforce of 578 employees would be (continued on next page)	No effects on support facilities and infrastructure.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
10a. Impacts on Support Facilities and Infrastructure (Construction) — continued				
would be expected to add approximately 466 daily round trips and 10 material/service trucks to the total ORNL traffic of 7,810 vehicle trips. Effects on traffic could include increased general congestion on existing access roads to the ORR.	would be expected to add approximately 466 daily round trips and 10 material/ service trucks to the total LANL traffic of 6,980 vehicle trips. Presently, the access route (State Highway 4) to the proposed site is a relatively lightly-traveled road providing access to Bandelier National Monument. Construction traffic would increase traffic on this road by approximately 45%, causing some congestion.	site and replace the existing Westgate Road access to ANL. Traffic on ANL access roads would increase approximately 7%. The estimated peak construction workforce of 578 employees would be expected to add approximately 466 daily round trips and 10 material/ service trucks to the total ANL traffic of 6,290 vehicle trips. Construction traffic would affect the composition and speed of the traffic, resulting in an increase in the general congestion on existing access roads.	expected to add approximately 466 daily round trips and 10 material/service trucks to the projected total BNL traffic of 2,500 vehicle trips. Because of the condition of the access roads to BNL, this increase is not considered significant.	
10b. Impacts on Support Facilities and Infrastructure (Operations)				
Operation of the proposed SNS at 4 MW would add 305 daily round trips and 3 service trucks per day, or a 5% increase over current traffic levels. Effects on traffic could increase general congestion on existing access roads to the ORR.	Operation of the proposed SNS at 4 MW would add 305 daily round trips and 3 service trucks per day, or a 4% increase over current traffic levels. Effects on traffic could increase general congestion on existing access roads to LANL.	Operation of the proposed SNS at 4 MW would add 305 daily round trips and 3 service trucks per day, or a 5% increase over current traffic levels. Effects on traffic could increase general congestion on existing access roads to ANL.	Operation of the proposed SNS at 4 MW would add 305 daily round trips and 3 service trucks per day, or a 12% increase over current traffic levels. Effects on traffic could increase general congestion on existing access roads to BNL. Because of the condition of the access roads to BNL, this increase is not considered significant.	No effects on support facilities and infrastructure.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
10b. Impacts on Support Facilities and Infrastructure (Operations) — continued				
Existing electrical service is adequate for the proposed 1-MW SNS and the 4-MW upgrade. Existing transmission lines would be extended approximately 3,000 ft. Environmental effects of construction the electrical feeder would be negligible.	The existing electrical power system at LANL does not have adequate capacity to meet the demands of the proposed SNS for a 1-MW or 4-MW facility. Meeting these demands would require construction of a 115-kV transmission line from the east side of the site, which would require a major reconfiguration of the system. Additional required efforts could include new power grid configurations and an SNS site-specific power generation station.	The existing electrical power system at ANL has sufficient capacity for the proposed SNS operating at 1-MW power. However, there is not sufficient capacity at ANL for the 4-MW SNS. Sufficient power is available from Commonwealth Edison. Approximately 6,600 ft of new 138-kV transmission line would be constructed to connect the proposed SNS to an adequate substation. The transmission line would be constructed in developed areas, so environmental effects would be minimal.	Existing electrical service at BNL is adequate for the proposed 1-MW SNS. However, in order to accommodate the 4-MW facility, a new 69-kV transmission line would be required extending to the Long Island Lighting Company's (LILCO's) 138-kV grid. This line would be approximately 1 mile in length and would parallel the existing 69-kV line. All upgrades would occur within existing utility corridors; therefore, environmental effects would be minor.	No effects on electrical service.
The existing steam supply at ORNL is adequate to meet the needs of the proposed SNS. If the decision is made to use ORNL steam, approximately 2 miles of steam line would be constructed. Much of the construction would be on previously disturbed land. Environmental effects would be expected to be minimal.	Steam is not available at or in the vicinity of the proposed SNS site. The SNS facility would include steam generation.	The existing steam supply at ANL is adequate to meet the needs of the proposed SNS. If the decision is made to use ANL steam, approximately 1,500 ft of steam line would be constructed, crossing developed land. Environmental effects would be expected to be minimal.	The existing steam supply at BNL is adequate to meet the needs of the proposed SNS. If the decision is made to use BNL steam, approximately 4,000 ft of steam line would be constructed, crossing developed land. Environmental effects would be expected to be minimal.	No effects on the steam supply.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
10b. Impacts on Support Facilities and Infrastructure (Operations) — continued				
The existing East Tennessee Natural Gas 22-in. gas main has adequate capacity to supply the proposed SNS. Approximately 5,000 ft of new gas line would be constructed along Chestnut Ridge Road, the main access road to the proposed site. <u>If the gas line will be on the southwest side of Chestnut Ridge Road, no wetland impacts should occur. If it is on the northeast side of the road, there may be an additional small area of wetland encroachment above that necessary for road construction.</u>	There is adequate capacity from the existing natural gas system at LANL to meet the needs of the proposed SNS. However, there are no existing gas lines in the vicinity of the proposed site. An expansion of the natural gas infrastructure would be necessary.	There is adequate capacity from the existing natural gas system at ANL to meet the needs of the proposed SNS. The natural gas system at ANL is scheduled to be upgraded in FY 1999. A high-pressure gas main is located near the proposed site. Modifications necessary to accommodate the proposed SNS could be accomplished during the scheduled upgrade.	There is sufficient capacity in the existing natural gas system at BNL to meet the needs of the proposed SNS. Approximately 4,000 ft of new gas line would be constructed, primarily across developed land. Environmental effects would be expected to be minimal.	No effects on natural gas system.
The existing 24-in. water main located adjacent to the proposed site has adequate capacity to supply water to the SNS.	The domestic water system at LANL can not meet the projected demands for LANL, including the proposed SNS and the surrounding communities. Accommodating the proposed SNS would require extensive upgrades to the delivery system, including new water mains, lift stations and storage tanks.	The domestic water system at ANL has sufficient capacity to meet the needs of the proposed SNS. In addition, ANL has a non-potable laboratory water supply the could be used for cooling tower makeup.	The domestic water system at BNL has sufficient capacity to meet the needs of the proposed SNS.	No effects on the domestic water system.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
10b. Impacts on Support Facilities and Infrastructure (Operations) — continued				
The existing sewage treatment plant at ORNL has adequate capacity to treat wastes from the proposed SNS.	The existing sewage treatment plant at LANL has adequate capacity to treat wastes from the proposed SNS. The plant is several miles from the proposed site. Sanitary sewage would have to be trucked to the treatment plant or a small package plant included in the SNS facilities.	The existing sewage treatment plant at ANL has adequate capacity to treat wastes from the proposed SNS.	The existing sewage treatment plant at BNL has adequate capacity to treat wastes from the proposed SNS.	No effects on sewage treatment.
11a. Impacts of Waste Management (Construction and Operations)				
<b>Hazardous Wastes</b> <u>Treatment</u> No hazardous waste treatment facilities at ORNL.  <u>Storage</u> Projected generation, excluding SNS, 1998–2040: 160 m <sup>3</sup> /yr.	<b>Hazardous Wastes</b> <u>Treatment</u> No hazardous waste treatment facilities at LANL.  <u>Storage</u> Projected generation, excluding SNS, 1998–2040: 942 m <sup>3</sup> /yr.	<b>Hazardous Wastes</b> <u>Treatment</u> No hazardous waste treatment facilities at ANL.  <u>Storage</u> Projected generation, excluding SNS, 1998–2040: 115 m <sup>3</sup> /yr.	<b>Hazardous Wastes</b> <u>Treatment</u> No hazardous waste treatment facilities at BNL.  <u>Storage</u> Projected generation, excluding SNS, 1998–2040: 200 drums/yr.	<b>Hazardous Wastes</b>
Total capacity available for SNS wastes: 139 m <sup>3</sup> /yr.	Total capacity available for SNS wastes: No long-term storage.			
Amount generated by SNS: 40 m <sup>3</sup> /yr.				

3-71

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
11a. Impacts of Waste Management (Construction and Operations) — continued				
<b>Hazardous Wastes (cont'd)</b> <u>Conclusion</u> Standard DOE practice has been to dispose of hazardous waste at off-site, DOE-approved, licensed commercial facilities. Implementation of proper handling, disposal, and waste minimization practices would result in minimal effects to the environment.				<b>Hazardous Wastes (cont'd)</b> <u>Conclusion</u> No waste generated, thus no effects from SNS on the environment.
<b>Low-Level Radioactive Wastes</b> <u>Treatment</u> Projected generation, excluding SNS, 1998–2040: 282,000 m <sup>3</sup> /yr (7.45E07 gal/yr). Total capacity available for SNS wastes: 423,920 m <sup>3</sup> /yr (1.12E08 gal/yr).	<b>Low-Level Radioactive Wastes</b> <u>Treatment</u> Projected generation, excluding SNS, 1998–2040: 21,880 m <sup>3</sup> /yr (5.78E06 gal/yr). Total capacity available for SNS wastes: 4,600 m <sup>3</sup> /yr (1.22E06 gal/yr).	<b>Low-Level Radioactive Wastes</b> <u>Treatment</u> Projected generation, excluding SNS, 1998–2040: 413,000 m <sup>3</sup> /yr (1.09E08 gal/yr). Total capacity available for SNS wastes: 1.00E06 m <sup>3</sup> /yr (2.64E08 gal/yr).	<b>Low-Level Radioactive Wastes</b> <u>Treatment</u> Projected generation, excluding SNS, 1998–2040: 190 m <sup>3</sup> /yr (50,000 gal/yr). Total capacity available for SNS wastes: 300 m <sup>3</sup> /yr (70,000 gal/yr).	<b>Low-Level Radioactive Wastes</b> <u>Conclusion</u> No waste generated, thus no effects from SNS on the environment.
Amount generated by SNS: 16,400 m <sup>3</sup> /yr (4.33E06 gal/yr).				
<u>Conclusion</u> No effects on low-level radioactive waste (LLW) treatment facilities would be anticipated, thus no effects to the environment are anticipated.	<u>Conclusion</u> Current treatment facilities do not have the capacity to treat all of the LLW from the proposed SNS. LLW with accelerator-produced tritium would not meet the waste acceptance criteria for the existing LLW treatment facility (RLWTF TA-50). However, a new facility is under construction that will accept these wastes, thus no (continued on next page)	<u>Conclusion</u> No effects on LLW treatment facilities would be anticipated. Tritium discharge would increase from 0.75 Ci/yr to 40 Ci/yr, potentially resulting in minor adverse impacts.	<u>Conclusion</u> SNS volume exceeds capacity. Wastes can be processed at a higher rate. Additional treatment capacity may be necessary, thus production of waste may have minor adverse impacts.	

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
11a. Impacts of Waste Management (Construction and Operations) — continued				
<b>Low-Level Radioactive Wastes (cont'd)</b>  <u>Storage</u> Projected generation, excluding SNS, 1998–2040: 2,520 m <sup>3</sup> /yr.  Total capacity available for SNS wastes: Limited storage available; long-term storage would not be necessary because contracts are in place that would allow for disposal of waste. Amount generated by SNS: 1,026 m <sup>3</sup> /yr.  <u>Conclusion</u> Additional storage capacity may be necessary to accommodate SNS wastes; however, long-term storage would not be necessary because standard DOE practice has been to dispose of wastes at off-site, DOE-approved, licensed commercial facilities, thus no effects to the environment are anticipated.	<b>Low-Level Radioactive Wastes (cont'd)</b> effects to the environment are anticipated.  <u>Storage</u> Facilities are under construction for treatment and disposition.          <u>Conclusion</u> Long-term storage facilities for LLW are not necessary at LANL. No effects to the environment are anticipated.	<b>Low-Level Radioactive Wastes (cont'd)</b>  <u>Storage</u> Projected generation, excluding SNS, 1998–2040: 232 m <sup>3</sup> /yr.  Total capacity available for SNS wastes: 30 m <sup>3</sup>      Amount generated by SNS: 1,026 m <sup>3</sup> /yr.  <u>Conclusion</u> Additional storage capacity may be necessary to accommodate SNS wastes; however, long-term storage would not be necessary because standard DOE practice has been to dispose of wastes at off-site DOE-approved, licensed commercial facilities. Implementation of proper handling, disposal, and waste minimization practices would result in minimal effects to the environment.	<b>Low-Level Radioactive Wastes (cont'd)</b>  <u>Storage</u> Projected generation, excluding SNS, 1998–2040: 283 m <sup>3</sup> /yr.  Total capacity available for SNS wastes: 270 m <sup>3</sup> /yr.      Amount generated by SNS: 1,026 m <sup>3</sup> /yr.  <u>Conclusion</u> No waste generated, thus no effects on the environment.	



Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
11a. Impacts of Waste Management (Construction and Operations) — continued				
<b>Low-Level Radioactive Wastes (cont'd)</b>  <u>Disposal</u> No LLW disposal at ORNL, thus no effects on the environment.	<b>Low-Level Radioactive Wastes (cont'd)</b>  <u>Disposal</u> Projected generation, excluding SNS, 1998–2040: 2,500 m <sup>3</sup> /yr.  Total capacity available for SNS wastes: 35,000 m <sup>3</sup> /yr. Amount generated by SNS: 1,026 m <sup>3</sup> /yr.  <u>Conclusion</u> No effect on LLW disposal facilities would be anticipated, thus no effects on the environment.	<b>Low-Level Radioactive Wastes (cont'd)</b>  <u>Disposal</u> No LLW disposal at ANL or BNL, thus no effects on the environment.		
<b>Mixed Wastes</b>  <u>Treatment</u> No mixed waste treatment facilities at ORNL, thus no effects on the environment.	<b>Mixed Wastes</b>  <u>Treatment</u> No mixed waste treatment facilities at LANL, thus no effects on the environment.	<b>Mixed Wastes</b>  <u>Treatment</u> Projected generation rate, excluding SNS, 1998–2040: 215 m <sup>3</sup> /yr.  Amount generated by SNS: 18 m <sup>3</sup> /yr.	<b>Mixed Wastes</b>  <u>Treatment</u> No mixed waste treatment facilities at BNL, thus no effects on the environment.	<b>Mixed Wastes</b>

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
11a. Impacts of Waste Management (Construction and Operations) — continued				
Mixed Wastes (cont'd)	Mixed Wastes (cont'd)	Mixed Wastes (cont'd)	Mixed Wastes (cont'd)	Mixed Wastes (cont'd)
		<u>Conclusion</u> Design capacity is much greater than anticipated volumes. If necessary, permitted volumes could be increased, thus no effects on the environment.		
<u>Storage</u> Projected generation rate, excluding SNS, 1998–2040: 20 m <sup>3</sup> /yr.	<u>Storage</u> Projected generation rate, excluding SNS, 1998–2040: 622 m <sup>3</sup> /yr.	<u>Storage</u> Projected generation rate excluding SNS, 1998–2040: 215 m <sup>3</sup> /yr.	<u>Storage</u> Projected generation rate, excluding SNS, 1998–2040: 2 m <sup>3</sup> /yr.	
Long-term storage of SNS waste is not anticipated. Shippable quantities of waste would be transferred to laboratory waste management for transport to a licensed, DOE approved, commercial disposal facility.				
Amount generated by SNS: 18 m <sup>3</sup> /yr.				
<u>Conclusion</u> No effect on mixed waste storage facilities would be anticipated because DOE has contracts in place for disposal of wastes as generated, as per the standard DOE practice of off-site disposal in licensed facilities. Implementation of proper handling, disposal, and waste minimization practices would result in no environmental effects.				<u>Conclusion</u> No waste generated, thus no effects on the environment.
All laboratories have waste certification processes in place to assure LLW and mixed wastes sent to off-site disposal facilities meet the waste acceptance criteria (WAC) of the facility. Because of the uncertainty of the composition of the LLW and mixed waste generated by the SNS, the waste may not meet the current WAC. Pretreatment of the waste at the SNS may be necessary. DOE may have to amend the licenses at the current disposal facilities to allow acceptance of wastes from the SNS.				

## PROPOSED ACTION

[illegible]

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
11a. Impacts of Waste Management (Construction and Operations) — continued				
Sanitary Wastes (cont'd)				Sanitary Wastes (cont'd)
Amount generated by SNS: 1,350 m³/yr.				
Conclusion No environmental effect anticipated.	Conclusion No effect anticipated. Sanitary wastes would be disposed of in off-site landfills, thus no environmental impacts are anticipated.			Conclusion No effect on sanitary waste facilities, thus no environmental impacts are anticipated.
12a. Impacts on Long-Term Productivity of the Environment (Operations)				
Localized effects on groundwater productivity would occur at the ORNL SNS site but not on the corresponding watershed.	Sustained use of groundwater by the SNS over time could lower water levels in wells and reduce long-term main aquifer productivity.	Localized effects on groundwater productivity would occur at the ANL SNS site but not on the corresponding watershed.		No effects on groundwater productivity.
Permanent commitment of 110 acres (45 ha) of forested land to the SNS. This represents less 0.5% of the forested area on the ORR.	Permanent commitment of 110 acres (45 ha) of piñon-juniper habitat to the SNS. This represents approximately 10% of the piñon-juniper habitat in TA-70.	Permanent commitment of 110 acres (45 ha) of land to the SNS. A large portion of this land has been previously disturbed.	Permanent commitment of 110 acres (45 ha) of land to the SNS. This represents less than 2% of the legally established Pine Barrens Protection Area. The proposed SNS site is entirely within the Compatible Growth Area.	No effects on the long-term productive potential of land.
13a. Cumulative Impacts (Construction and Operations)				
The proposed action would contribute to cumulative impacts through localized radionuclide contamination of groundwater.				This alternative would not contribute to cumulative impacts involving radionuclide contamination of groundwater.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
13a. Cumulative Impacts (Construction and Operations) — continued				
The potential cumulative impact of incremental emissions would be evaluated and permitted on a case-by-case basis by the state and federal air quality agencies at the appropriate juncture in order to protect public health and welfare.				This alternative would not contribute to cumulative impacts on incremental emissions.
No cumulative impacts are predicted for noise.				This alternative would not contribute to cumulative impacts on noise.
The proposed action would not contribute to cumulative impacts on terrestrial resources.	The proposed action would not contribute to cumulative impacts on terrestrial resources.	Clearing 15% of the undeveloped land at ANL for the SNS and APS would significantly decrease the terrestrial wildlife inhabiting ANL. Except for fallow deer, no rare or important game animals would be affected.	The proposed action would not contribute to cumulative impacts on terrestrial resources.	This alternative would not contribute to cumulative impacts on terrestrial resources.
<u>Cumulative impacts on wetlands would be minimal because wetlands would be created or restored to replace those lost to construction.</u>				This alternative would not contribute to cumulative impacts on wetlands.
No cumulative impacts are anticipated on aquatic resources.				This alternative would not contribute to cumulative impacts on aquatic resources.
Cumulative impacts on protected species would be expected to be minimal.				This alternative would not contribute to cumulative impacts on protected species.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
13a. Cumulative Impacts (Construction and Operations) — continued				
The activities at ORNL account for only about 7% of the employment, wage and salary, and business activities of the area. Cumulative impacts of SNS on the economy, housing, and community infrastructure would be minimal.	The activities at LANL account for about one-third of the employment, wage and salary, and business activities of the area. Some positive benefits would occur in the form of new jobs but cumulative impacts of SNS on the economy, housing, and community infrastructure would be minimal overall.	The activities at ANL account for much less than 1% of the employment, wage and salary, and business activities of the area. Cumulative impacts of SNS on the economy, housing, and community infrastructure would be minimal.	The activities at BNL account for much less than 1% of the employment, wage and salary, and business activities of the area. Cumulative impacts of SNS on the economy, housing, and community infrastructure would be minimal.	No cumulative impacts on the economy, housing, and community infrastructure.
There would be no cumulative impacts involving environmental justice issues.				This alternative would not contribute to cumulative impacts involving environmental justice issues.
The proposed action would not contribute to cumulative impacts on prehistoric cultural resources.	Twenty prehistoric archaeological sites in the 65% surveyed area would be destroyed by construction of the proposed SNS and expansion of LLW Disposal Facility in TA-54. The potential contribution of the other 35% of the proposed SNS site cannot be accurately assessed. If the proposed SNS site is chosen for construction of the SNS, this area would be surveyed and assessed for cumulative impacts on prehistoric cultural resources prior to construction.	Prehistoric site 40DU207, adjacent to the proposed SNS site, may be disturbed or destroyed by SNS construction. ANL has not assessed the NRHP eligibility of this site. Site 40DU189 on the Advanced Photon Source (APS) site was once thought to be potentially NRHP-eligible, but it was later determined to not be a prehistoric cultural resource. If 40DU207 is a cultural resource, the proposed action, along with the APS project, (continued on next page)	The proposed action would not contribute to cumulative impacts on prehistoric cultural resources.	This alternative would not contribute to cumulative impacts on prehistoric cultural resources.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
13a. Cumulative Impacts (Construction and Operations) — continued				
		would not contribute to cumulative impacts on prehistoric cultural resources at ANL because 40DU189 is not a prehistoric cultural resource.		
The proposed action would not contribute to cumulative impacts on historic cultural resources.	Implementation of the proposed action within the 65% surveyed area at the proposed SNS site would not contribute to cumulative impacts on historic cultural resources. The potential contribution of the other 35% cannot be accurately assessed. If this site is chosen for construction of the proposed SNS, this area would be surveyed and assessed for cumulative impacts on historic cultural resources prior to construction.	The proposed action would not contribute to cumulative impacts on historic cultural resources.		This alternative would not contribute to cumulative impacts on historic cultural resources.
The proposed action would not contribute to cumulative impacts on TCPs.	Cumulative impacts on 20 prehistoric archaeological sites (all TCPs) destroyed by construction of the proposed SNS and expansion of LLW Disposal Facility in TA-54. If any prehistoric archaeological sites are located (continued on next page)	The proposed action would not contribute to cumulative impacts on TCPs.	The proposed action would not contribute to cumulative impacts on TCPs.	This alternative would not contribute to cumulative impacts on TCPs.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
13a. Cumulative Impacts (Construction and Operations) — continued				
	within the unsurveyed 35 percent of the proposed SNS site, these TCPs would also be destroyed during construction. Cumulative impacts on water resources are also impacts on TCPs (see related entries under this table heading). Because specific identities and locations of TCPs at sites of the proposed SNS and other analyzed actions are not known, cumulative impacts on such specific resources would be uncertain.			
The proposed action would contribute minimally to cumulative impacts on undeveloped ORR land.	The proposed action would contribute minimally to cumulative impacts on undeveloped LANL land.	The SNS and APS would introduce development to about 160 acres (65 ha) of undeveloped land. This would reduce the already limited area of undeveloped ANL land available for development by about 15%.	The proposed action would contribute minimally to cumulative impacts on undeveloped land at BNL.	This alternative would not contribute to cumulative impacts on undeveloped land.
The proposed action would contribute minimally to cumulative impacts on areas of ORR land in current use categories.	The proposed action would contribute minimally to cumulative impacts on areas of LANL land in current use categories.	The SNS and APS would reduce Open Space land at ANL by 145 acres (59 ha). This would further reduce the already limited area of Open Space ANL land available for development by about 15%.	The proposed action would contribute minimally to cumulative impacts on areas of BNL land in current use categories.	This alternative would not contribute to cumulative impacts on areas of land in current use categories.



Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
13a. Cumulative Impacts (Construction and Operations) — continued				
The proposed action, CERCLA Waste Disposal Facility, Parcel ED-1, and JINS would reduce the environmental research potential of 981 acres (391 ha) of National Environmental Research Park (NERP) land on the ORR. This cumulative impact would be minimal because only 4.5% of the NERP land on the ORR would be affected. The cumulative impacts of these actions on environmental research projects are uncertain.	The proposed action, construction of a new LLW disposal facility in TA-67, and construction of a new road to support pit production would reduce the environmental research potential of 177 acres (72 ha) of NERP land. This cumulative impact would be Minimal because only 0.6% of the NERP land at LANL would be affected. The land on and in the vicinity of the proposed SNS site is not being used for environmental research projects. As a result, the proposed action would not contribute to cumulative impacts on uses of the land by environmental research projects. Because no future environmental research projects are planned for this land, cumulative impacts on specific future projects cannot be assessed.	No NERP land is present at ANL. Consequently, the proposed action would not reduce the environmental research potential of NERP land. The land on and in the vicinity of the proposed SNS site, including Ecology Plot Nos. 6, 7, and 8, is not being used by environmental research projects. As a result, the proposed action would not contribute to cumulative impacts on the use of land by such projects. Because no future environmental research projects are planned for this land, cumulative impacts on specific future projects cannot be assessed.	No NERP land is present at BNL. Consequently, the proposed action would not reduce the environmental research potential of NERP land. The land on and in the vicinity of the proposed SNS site is not being used by environmental research projects. As a result, the proposed action would not contribute to cumulative impacts on the use of land by such projects. Because no future environmental research projects are planned for this land, cumulative impacts on specific future projects cannot be assessed.	No cumulative impacts on NERP land or environmental research projects.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
13a. Cumulative Impacts (Construction and Operations) — continued				
The SNS and CERCLA Waste Management Facility [White Wing Scrap Yard (high-end scenario)] would be collectively at variance with Common Ground zoning for future use of their sites in Conservation Area Uses.	The proposed action would not contribute to cumulative impacts on zoning of land for future use.			This alternative would not contribute to cumulative impacts on zoning of land for future use.
The proposed action would contribute minimally to cumulative impacts on recreational land use but not at all on parks and preserves.				This alternative would not contribute to cumulative impacts on parks, preserves, or recreational land uses.
The proposed action would not contribute to cumulative impacts on visual resources.	The proposed action would not contribute to cumulative impacts on visual resources.	<u>Current views within ANL and along the ANL fence inside the Waterfall Glen Nature Preserve already contain buildings and other features characteristic of development. Consequently, the cumulative impacts of the SNS and APS facilities on visual resources would be minimal.</u>	The proposed action would not contribute to cumulative impacts on visual resources.	This alternative would not contribute to cumulative impacts on visual resources.
Minimal cumulative radiological impacts on human health from normal ORNL and SNS operations. Minor increases in traffic due to the proposed SNS project and development of Parcel ED-1 may minimally reduce the level of service on roads.	Minimal cumulative radiological impacts on human health from normal LANL and SNS operations.	Potential for adverse radiological impacts on human health from normal ANL and SNS operations.	Potential for adverse radiological impacts on human health from normal BNL and SNS operations.	This alternative would not contribute to radiological impacts on human health.
	Minimal cumulative impacts on transportation.			This alternative would not contribute to cumulative impacts involving transportation.

Table 3.5-1. Comparison of impacts among alternatives (continued).

PROPOSED ACTION				NO-ACTION ALTERNATIVE
ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative	
13a. Cumulative Impacts (Construction and Operations) — continued				
Minimal cumulative impacts on electric power supply capabilities.	The power demand of the SNS, DAHRT facility, and continued LANL operations would exceed the delivery capacity of the electric power pool that serves the laboratory.	Adequate power is available, but new power lines would need to be installed.	Minimal cumulative impacts on electric power supply capabilities.	This alternative would not contribute to cumulative impacts on electric power supply capabilities.
Waste management facilities at ORNL, LANL, ANL, and BNL have sufficient capacity to handle the waste volume projected for the period 1998–2040, including the wastes from the proposed SNS. Additionally, standard DOE practice has been to dispose of hazardous waste at off-site DOE-approved, licensed facilities. Therefore, construction and operation would have a minimal contribution to cumulative impacts on waste management facilities.				This alternative would not contribute to cumulative impacts on waste management.

This page intentionally left blank.